United States Department of the Interior
Bureau of Land Management

Elko Field Office
Elko, Nevada

March 2002

DRAFT Environmental Impact Statement

Leeville Project

MISSION STATEMENT

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based upon the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include recreation, rangelands, timber, minerals, watershed, fish and wildlife, wilderness, air and scenic, scientific and cultural values.

BLM/EK/PL-02/008 + 1793

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Elko Field Office
3900 East Idaho Street
Elko, Nevada 89801-4611
http://www.nv.blm.gov

FEB 3 2002

In Reply Refer To:
1793.7/3809
N16-97-004P

Dear Reader:

Enclosed for your review and comment is the Draft Environmental Impact Statement (DEIS) for Newmont Mining Corporation's Leeville Project. The DEIS analyzes the effect of developing and operating an underground mine and ancillary facilities including dewatering operations for eighteen years. The Leeville Project consists of the West Leeville, Four Corners, and Turf ore bodies which will be accessed by five shafts, a waste rock disposal facility, and other ancillary facilities, including dewatering facilities. The Leeville Mine is located approximately 20 miles northwest of Carlin, Nevada.

A separate report entitled *Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project* analyzes the cumulative effects of dewatering from the three major dewatering projects on the Carlin Trend. This report is summarized in the DEIS and is available from the Bureau of Land Management, Elko Field Office, or on the internet at www.nv.blm.gov/elko.

This DEIS addresses those concerns identified by the BLM or raised during public scoping from August 1 through September 2, 1997. Following the 60 day public review and comment period, a Final EIS will be prepared. It will include monitoring and mitigation measures that address predicted direct, indirect, and cumulative impacts from Newmont's proposed mining and dewatering operations.

Public comments on the DEIS will be accepted during a 60-day comment period ending April 29, 2002. A public meeting to accept verbal and written comments is scheduled for April 3, 2002 at 6:00 P.M. at the BLM Elko Field Office. Comments on the DEIS should be submitted to: Bureau of Land Management, Elko Field Office, Attention: Deb McFarlane, Leeville Project EIS Coordinator, 3900 Idaho St., Elko, NV 89801.

The Final EIS may be published in an abbreviated format so please retain this draft document for future reference. Your interest in the management of public lands is appreciated. If you have any questions, please contact Deb McFarlane, Leeville EIS Project Manager at (775) 753-0200.

Sincerely,

David Stout

for Helen Hankins,
Field Manager

DRAFT
ENVIRONMENTAL IMPACT STATEMENT
NEWMONT MINING COMPANY
LEEVILLE PROJECT

LEAD AGENCY: U.S. Department of the Interior
Bureau of Land Management
Elko Field Office
Elko, Nevada

PROJECT LOCATION: Elko and Eureka Counties, Nevada

COMMENTS ON THIS DRAFT EIS SHOULD BE DIRECTED TO:
Deb McFarlane
Leeville EIS Project Manager
Bureau of Land Management
Elko Field Office
3900 East Idaho Street
Elko, NV 89801

DATE DRAFT EIS FILED WITH USEPA: March 1, 2002

DATE BY WHICH COMMENTS MUST BE POSTMARKED TO BLM: April 29, 2002

ABSTRACT

This draft environmental impact statement (DEIS) analyzes potential impacts associated with Newmont Mining Company's (Newmont) proposal to develop the Leeville Project; a proposed underground gold mine located approximately 20 miles northwest of Carlin, Nevada in the Carlin Trend. Newmont submitted a plan of operations (Proposed Action) for development of the Leeville Project in April 1997. The Proposed Action provides for construction of five shafts to depths of approximately 2,500 feet from the surface to access three main ore bodies. The Proposed Action also includes construction of ancillary mine facilities to support underground operations including shaft hoists, a waste rock disposal facility, a refractory ore stockpile facility, facilities to support backfill of mined-out stopes, installation and operation of mine dewatering wells, a water treatment plant, a pipeline/canal system to discharge excess mine water to existing infiltration and irrigation systems in the Boulder Valley, and reclamation of surface disturbances including capping of shafts. Approximately 486 acres of land would be disturbed by mine facilities including 33 acres of private land and 453 acres of public land. The Leeville Project would have an 18-year mine life and would produce approximately 18 million tons of ore and waste rock. In addition to the Proposed Action and the no action alternative, the DEIS analyzes three alternatives, including A) eliminate canal portion of water discharge pipelines, B) backfill shafts, and C) relocation of the waste rock disposal facility and refractory ore stockpile. The Agency Preferred Alternative incorporates portions of the proposed action and alternatives A, B, and C.

Responsible Official for DEIS: David Stout

for **Helen Hankins**
Manager, Elko Field Office

DRAFT ENVIRONMENTAL IMPACT STATEMENT
LEEVILLE PROJECT

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

LIST OF TABLES

TABLE OF CONTENTS (continued)

Page

TABLE OF CONTENTS (continued)

Page

LIST OF FIGURES

LIST OF APPENDICES

SUMMARY

Newmont Mining Corporation (Newmont) proposes to develop and operate an underground mine with associated surface support facilities at the Leeville Project in Eureka County, Nevada. The Project would result in development of an underground mine; construction of a waste rock disposal facility, refractory ore stockpiles, and ancillary facilities; rerouting and upgrading an existing access road to a haul road; construction of a water treatment facility to treat discharge water; installation of a pipeline to deliver water from the Leeville Project dewatering well system to the TS Ranch Reservoir and irrigation system; continuation of geologic evaluation and exploration activities; and rerouting an existing Sierra-Pacific power line. Development of the Leeville Project is described in a Plan of Operations (Newmont 1997a) submitted in April 1997 to the Elko Field Office of the Bureau of Land Management (BLM).

The Leeville Project is located on public and private land in Eureka County, Nevada approximately 20 miles northwest of Carlin, Nevada. BLM reviewed the Plan of Operations submitted by Newmont and determined that the proposed Leeville Project (Proposed Action) has the potential to result in significant environmental impacts and preparation of an Environmental Impact Statement (EIS) would be required.

This EIS describes Newmont's Proposed Action, reasonable alternatives to the Proposed Action, and environmental consequences that could result from implementation of these actions. Potential direct, indirect, and cumulative effects on the environment have been analyzed for the Proposed Action. Alternatives were developed and analyzed for potential direct and indirect effects. The evaluation in this EIS has been completed to the extent necessary to determine whether potential impacts are significant. Impacts described in this EIS will form the basis for a BLM decision regarding the Proposed Action, alternatives, and selection of appropriate mitigation measures. No distinction is made in this EIS between potential impacts on public versus private land that would result from the possible authorizations by BLM.

SUMMARY OF PROPOSED ACTION

Implementation of Newmont's Proposed Action would result in removal of ore and waste rock from multiple underground ore deposits identified as West Leeville, Four Corners, and Turf. Five shafts (four ventilation and one production) would be constructed to support underground mining for production, underground access, and ventilation. Approximately 18 million tons of ore and waste rock would be removed over an 18-year mine life.

Construction of mine shafts and surface support facilities would disturb approximately 453 acres of public land and 33 acres of private land. The mine would extend approximately 2,500 feet below existing ground surface.

Ore and waste rock would be drilled, blasted, and hoisted to the surface. Most mined-out stopes would be backfilled with cemented rock fill. Development waste rock would be used for stope backfill whenever possible.

Ore hoisted to the surface would be hauled directly to processing facilities at the Refractory Ore Treatment Plant (Mill #6) located at Newmont's South Operations Area or placed in a refractory ore stockpile approximately one-half mile west of the production shaft. Temporary refractory ore stockpiles would be constructed in accordance with Newmont's Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a)

Refractory ore stockpiles would be built on low permeability bases compacted and sloped to allow drainage to a collection point. Ditches would be constructed around the base of each stockpile to divert surface runoff away from the area. Solution would be captured in a sediment pond for sampling and sediment control. Any acid-generating refractory material deemed as waste at the end of the Project would be encapsulated in place or moved to encapsulation cells constructed at the waste rock disposal facility.

Since ore deposits at the Leeville Project lie below the water table, dewatering wells would be needed to control inflow to underground workings. Newmont proposes to complete up to 35 dewatering wells, pumping at a maximum collective rate of 25,000 gallons per minute, to lower the existing water table to an approximate elevation of 3,800 feet above mean sea level (AMSL). Localized water that is not intercepted by the network of dewatering wells and enters the mine workings would be routed to one or more central sumps and pumped to a mine water sump on the surface. Mine water would be used for mine development and dust control at the Project area.

Excess discharged groundwater remaining after mine development and dust control requirements have been met would be routed to infiltration basins (including TS Ranch Reservoir), the irrigation system, or as a contingency, to the Humboldt River via the Boulder Valley conveyance system.

Groundwater discharged to the Humboldt River would require authorization from the Nevada State Engineer and, in addition to treatment for contaminants, may require cooling to meet discharge temperature requirements. Newmont would use Barrick’s cooling towers to reduce the temperature of discharge water to meet State of Nevada water quality standards. Water from the Leeville Project would be treated to meet State of Nevada water quality standards prior to discharge to the TS Ranch Reservoir. Discharge would not be allowed to reach the Humboldt River unless excess water cannot be removed via infiltration and/or irrigation within the Boulder Valley.

Excess groundwater would be transported from dewatering wells to Barrick's Boulder Valley conveyance system, located about 5.5 miles west of Leeville, through a gravity-fed, 42-inch diameter pipeline and canal system. The pipeline would be buried except for rocky areas, where it would be constructed on ground surface. The last 5,700 feet of the proposed system would be constructed as an open canal. The canal would begin near the western edge of Section 1, T35N, R49E, and continue to its terminus at Barrick's existing cooling canal located near the TS Ranch Reservoir.

Development of the Leeville Project would require construction of a new waste rock disposal facility with a capacity of up to 4 million tons. A portion of the waste rock to be produced would be potentially acid-generating material (PAG). The combination of potentially acid-producing rock with other non-acid-producing rock is expected to result in a net acid-neutralizing waste rock disposal facility. The proposed waste rock disposal facility would be constructed in accordance with Newmont's Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a).

In cases where acid-base accounting (ABA) indicates the total mixture of waste rock is acid-generating, waste rock would be placed on a base constructed of compacted, low permeability materials, designed to prevent vertical migration of fluids. Encapsulation would be achieved by placing the toe of the sulfide material back from the perimeter of the ultimate footprint of the waste rock disposal facility to allow placement of an outer cover of acid-neutralizing waste rock. Surface drainage upstream of the base perimeter would be diverted with ditches to prevent run-on to the disposal facility.

A low permeability cap would be constructed on the final lift of the PAG cell. The cap would be constructed of random wheel compacted clay or alluvium to provide a barrier to fluid migration.

Haul and access roads would be constructed or upgraded to provide haul truck access to the production shaft and other surface support facilities. Ancillary facilities at the Leeville Project would be located above – and below-ground. An existing Sierra Pacific Power Company transmission line would be rerouted to avoid the proposed shafts and surface support facilities.

Reclamation activities would include regrading of the waste rock disposal facility, removal of structures after cessation of operations, capping shafts, regrading of disturbed areas (including roads), drainage control, well closure (e.g., dewatering wells, piezometers), removal and regrading of stockpile areas, replacement of salvaged soil, revegetation, and reclamation monitoring. The reclamation schedule would encompass the period between cessation of mining through revegetation. Reclamation activities would be completed approximately 8 years after mining ceases.

PROJECT ALTERNATIVES

Issues raised during public scoping and agency review of the Proposed Action were used to identify potential impacts that could result from the proposed Leeville Project. In general, potentially adverse effects that were identified include effects of the canal segment of the water discharge pipeline system on wildlife, long-term safety associated with closure of the production and ventilation shafts, and opportunity to reduce the amount of land disturbance associated with the Proposed Action.

Four alternatives are described in this section of the EIS: **Alternative A –** Eliminate Canal Portion of Water Discharge Pipeline System; **Alternative B** – Backfill Shafts; **Alternative C** – Relocate Waste Rock Disposal Facility and Refractory Ore Stockpile; and the **No Action Alternative**.

ALTERNATIVE A – ELIMINATE CANAL PORTION OF WATER DISCHARGE PIPELINE SYSTEM

Alternative A would include implementation of all components of the Proposed Action and would require Newmont to eliminate the canal at the end of the proposed water discharge system. Newmont would extend the proposed pipeline to replace the canal.

ALTERNATIVE B – BACKFILL SHAFTS

Alternative B would include implementation of all components described in the Proposed Action and would require Newmont to backfill the production and ventilation shafts associated with the Leeville Project. Newmont would use waste rock generated from the mining operation as backfill for the shafts and overburden in the uppermost portion of the shaft to facilitate revegetation.

Backfilling the shafts would eliminate the need for reinforced concrete closures Newmont has proposed for the shafts. The uppermost portion of the shaft would be backfilled with overburden and revegetated.

ALTERNATIVE C – RELOCATION OF THE WASTE ROCK DISPOSAL FACILITY AND REFRACTORY ORE STOCKPILE

Alternative C would incorporate all components of the Proposed Action but Newmont would relocate the proposed Waste Rock Disposal Facility and Refractory Ore Stockpile to Section 3, T35N, R50E. Construction of these mine facilities would occur on Newmont's existing North Area Leach facilities and not result in new disturbance in Section 3. Implementation of Alternative C would result in 118 acres less new disturbance on land in Section 10, T35N, R50E.

The area in Section 3 proposed for the Leeville Mine Waste Rock Disposal Facility and Refractory Ore Stockpile is currently used as a refractory ore stockpile for Newmont's North Area Operations and was constructed in accordance with Newmont's Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a). Reclamation of the Leeville Waste Rock Disposal Facility and Refractory Ore Stockpile would be consistent with the approved reclamation plan for the North Area Leach and includes regrading the surface of the facility, placement of growth media, and seeding.

NO ACTION ALTERNATIVE

Under the No Action Alternative, the Proposed Action would not be approved. Newmont would not be authorized to develop the defined ore reserves, construct ancillary mine facilities, place waste rock in the disposal facility, or construct the dewatering system discharge pipeline on public land. Potential impacts predicted to result from development of the Project would not be realized.

AGENCY PREFERRED ALTERNATIVE

The agency preferred alternative is Alternative A, Eliminate Canal Portion of Water Discharge Pipeline System; B, Backfill Shafts; and, C, Relocation of the Waste Rock Disposal Facility and Refractory Ore Stockpile.

SUMMARY OF IMPACTS

Analysis of potential impacts and mitigation associated with Newmont's proposed Leeville Project is presented in Chapter 4 – *Consequences of the Proposed Action and Alternatives*. The following is a summary of potential impacts, by resource, resulting from the Proposed Action and Alternatives.

PROPOSED ACTION

GEOLOGY AND MINERALS

Direct impacts to the geologic resource associated with implementation of the Proposed Action include relocation of approximately 3 million tons of waste rock and 14 million tons of ore. Indirect impacts could include potential discharge of acidic water from waste rock disposal facilities and sulfide-bearing ore stockpiles. Waste rock and refractory ore produced from Leeville ore bodies have potential for leaching antimony, arsenic, manganese, nickel, selenium, and sulfate. Static geochemical and leach extraction acid-base accounting (ABA) test results indicate that about 8 percent of ore and waste rock that would be generated under the Proposed Action is potentially acid-generating (PAG). Meteoric Water Mobility Procedure (MWMP) tests completed on rock from the Leeville Project site indicate that waste rock and refractory ore have potential for leaching some metals (see *Geology and Minerals* section in *Chapter 3*).

Newmont has developed a program for controlling acid generation and leachate migration in stockpiles to prevent adverse environmental effects resulting from stockpiled mine rock. Newmont has also proposed reclamation methods for waste rock facilities to prevent post-mining acid generation within the stockpiles. These methods are described in greater detail in *Chapter 2.*

PALEONTOLOGICAL RESOURCES

No known fossil quarries or vertebrate fossils are located in the area to be physically disturbed by the Proposed Action and therefore would result in no identified impacts to paleontological resources.

AIR QUALITY

Fugitive dust emissions would be generated by mining, processing, hauling, and stockpiling ore. Gaseous pollutant emissions would result from blasting, construction and mining equipment, and vehicle exhaust. Maximum potential hourly mercury emissions would not increase due to processing of Leeville ore at the South Operations Area. Emissions from the Leeville Project would not affect air quality or visibility in any Class I Airshed areas.

WATER QUANTITY AND QUALITY

Removal of groundwater using dewatering wells in the Leeville Mine area would be the primary cause of water-related impacts from the Proposed Action. The proposed dewatering wells would increase the depth of groundwater drawdown in a portion of the existing cone of depression created by current dewatering systems at the Goldstrike Property and Gold Quarry Mine. A total of about 360,000 acre-feet of water would be removed by Leeville dewatering from the regional aquifer system during the life-of-mine. Approximately 212,000 acre-feet of this water would be infiltrated into the Boulder Valley via irrigation, TS Ranch Reservoir, and other infiltration basins. Of the remaining 148,000 acre-feet, 133,500 acre-feet would be consumed by irrigation systems in the Boulder Valley, and approximately 14,500 acre-feet would be used by the mining operation.

A water treatment plant would be constructed at Leeville to treat excess mine water to necessary standards. Therefore, no impacts would occur to water quality from the excess mine discharge in Boulder Valley. Minor, short-term impacts to groundwater quality (e.g, nitrate and some metals) could occur immediately surrounding underground workings as the water table rises during recovery of the cone of depression. Minor increases in sedimentation would occur on the surface during construction and reclamation activities.

Dewatering at Leeville would extend the period to 90 percent recovery of the premining water table elevation in the Carlin Trend by about 20 years. This would include recovery of groundwater levels, flow from springs/seeps, and flow in affected streams. Reductions in baseflow resulting from adding Leeville Project dewatering to existing mine dewatering in the

Carlin Trend are predicted to be 0.1 cubic foot per second (cfs) or less for each of the potentially affected streams (Maggie, Boulder, Marys, and Beaver creeks) and the Humboldt River. Overall recovery to equilibrium conditions of hydrologic systems affected by regional dewatering in the Carlin Trend would be approximately 250 years in the vicinity of the Leeville Project area.

SOILS

Potential impacts on soil resources include loss of soil during salvage and replacement, sediment loss due to erosion, and reduced biological productivity over a surface disturbance area of 486 acres. These impacts are expected to be minimized following successful reclamation of disturbed land. Some disturbed areas, such as rock faces would not be reclaimed following completion of the Project.

VEGETATION

The Proposed Action would result in disturbance to 486 acres of rangeland vegetation communities at the mine site, along the discharge pipeline and canal route, ancillary facility sites, and haul roads. Potential impacts to riparian vegetation resulting from the Proposed Action would be limited to an extension of the duration of the water table drawdown currently impacted by existing dewatering operations in the Carlin Trend. See Wetlands/Riparian Zones section in this summary.

INVASIVE, NONNATIVE SPECIES

Potential exists for invasion or spread of noxious weeds onto disturbed areas as a result of the Proposed Action.

WETLANDS/RIPARIAN ZONES

Dewatering activities associated with the Leeville Project would prolong water table recovery to 90 percent of premining water table conditions within the area directly affected by Leeville's dewatering by approximately 20 years. This would delay restoration of up to 70 acres of wetlands and riparian zones potentially impacted by existing dewatering activities in the Carlin Trend. Wetlands and riparian zones potentially affected by Leeville dewatering include upper Simon Creek, upper Lynn Creek, Welches Creek, James Creek, and portions of Maggie Creek (the Narrows). Discharge of water from Leeville's dewatering system to the TS Ranch Reservoir would result in a continuation of flow that supports springs and riparian zones in the Boulder Valley including Sand Dune, Green, and Knob springs.

Base flow loss to area streams (e.g., Marys, Maggie, Beaver, and Boulder creeks and the Humboldt River) caused by adding Leeville dewatering pumping to other dewatering operations in the Carlin Trend is predicted to be 0.1 cfs or less for each affected waterbody.

FISHERIES AND AQUATIC RESOURCES

Dewatering activities at the proposed Leeville Project would prolong water table recovery to 90 percent of premining water table conditions within the area directly affected by Leeville's dewatering by approximately 20 years. This would result in a longer time period for recovery of stream flow potentially reduced by current dewatering operations in the Carlin Trend thus lengthening the time frame for recovery of any impacted aquatic habitat in these streams. Streams included in the direct impact area associated with the Leeville Project dewatering system include upper Simon Creek, upper Lynn Creek, and middle Maggie Creek (the Narrows).

The magnitude of base flow loss to area streams (e.g. Marys, Maggie, Beaver, and Boulder creeks, and the Humboldt River) caused by adding Leeville dewatering pumping to the other dewatering operations in the Carlin Trend at any given time is predicted to be 0.1cfs or less for each affected waterbody.

TERRESTRIAL WILDLIFE

Impacts to wildlife resources as a result of the Proposed Action would include direct loss of habitat and loss or displacement of wildlife from affected habitat. Direct loss of wildlife habitat would eliminate cover/nesting, hiding, breeding sites, and forage over 486 acres of surface disturbance. Associated human activity and alterations to existing natural resources are expected to have minimal impact on wildlife resources in the Project area.

THREATENED, ENDANGERED, CANDIDATE AND SENSITIVE SPECIES

Direct and indirect impacts to threatened, endangered, candidate, and sensitive species or their habitat would include incremental loss of habitat or prey base due to mine disturbance. Species habitat that would be potentially affected by Leeville Project development include goshawks, burrowing owls, sage grouse, and ferruginous hawks. Lahontan cutthroat trout, springsnails, spotted frogs, and California floaters have not been documented in any stream segments directly impacted by Leeville dewatering activities, but some of these species could be located in the cumulative drawdown area.

The magnitude of base flow loss to area streams (e.g., Maggie, Marys, Beaver, and Boulder creeks and the Humboldt River) caused by adding Leeville dewatering to other dewatering operations in the Carlin Trend at any given time would be 0.1 cfs of less for each affected waterbody. Portions of three streams that support LCT (e.g., upper Coyote Creek, upper Little Jack Creek, and a mid-section of Beaver Creek) are within the predicted cumulative cone of depression in the Carlin Trend. Other stream segments and springs within the cumulative effects drawdown area support springsnails.

GRAZING MANAGEMENT

The majority of the Project area has been fenced to exclude grazing due to on-going mining activity that predates Leeville. Approximately 264 acres of the proposed mine area currently open to grazing would be fenced to preclude grazing for the life of the Project. This would amount to a decrease of 36 animal unit months (AUMs) in the T Lazy S grazing allotment.

Livestock grazing potentially affected by loss of water availability due to dewatering activities in the Carlin Trend would continue to be impacted for an additional 20 year period as a result of the Proposed Action.

RECREATION AND WILDERNESS

Potential impacts of the Proposed Action on recreation would be fewer acres available for recreational activities during operation and after cessation of mining until reclamation is complete. Impacts to existing campgrounds and other area recreational opportunities are expected to be minimal relative to existing conditions. Wilderness and Wilderness Study Areas (WSAs) would not be impacted by the Proposed Action.

ACCESS AND LAND USE

The Proposed Action would not affect rights-of-way for Barrick's communication site and access road or Sierra Pacific Power Company's powerline along the North-South Haul Road. An amendment to an existing Sierra Pacific Power Company right-of-way allowing rerouting of approximately 3,800 feet of existing powerline through the proposed mine area would be submitted to BLM for approval. Existing access into the Project area is controlled by Newmont and Barrick. The Proposed Action would not result in a change in current access restrictions.

NOISE

The Leeville Project would result in an increase in noise generated by mining and ore-processing activities in the North Operations Area. Noise generated would not affect residential areas.

VISUAL RESOURCES

The primary impact of the Proposed Action would be large-scale modification of landforms. Angular, blocky forms and horizontal lines would create moderate contrasts with the natural rounded, rolling hills and ridges of the characteristic landscape. Clearing of vegetation in mine facility areas would create weak to moderate color contrasts with the existing landscape. New lines would be introduced delineating the edges of cleared areas and some change in texture would be seen, but overall contrast would be weak.

Visual impacts would be short-term as reclamation would reduce visual contrast associated with the Proposed Action.

CULTURAL RESOURCES

Thirty-one cultural resource sites are located within the Area of Direct Effect, none of which are eligible or potentially eligible to the National Register of Historic Places. One prehistoric site located in the Surrounding Area of Effect has been determined eligible to the National Register based on Criterion D. However, no impact to this property would occur as a result of the Proposed Action or Alternatives.

NATIVE AMERICAN RELIGIOUS CONCERNS

Implementation of the Proposed Action and Alternatives would have no direct or indirect impacts on Newe/Western Shoshone traditional cultural values, practices, properties, or human remains.

SOCIAL AND ECONOMIC RESOURCES

Positive impacts that would occur under the Proposed Action would be continued direct employment in the mining industry and secondary employment in the retail and service sectors in the study area; continued income generated from wages paid by Newmont and by secondary job employers within area communities; and continued tax base support including property taxes and net proceeds of mining taxes paid by Newmont for the Leeville mining operation collected by local and state jurisdictions. Negative impacts would be temporary and minimal because a small number of construction and operational workers are expected to be hired outside the local labor area.

ENVIRONMENTAL JUSTICE

There would be no disproportionate impacts to minority or low-income populations resulting from implementation of the Proposed Action and Alternatives.

ALTERNATIVES

The following is a summary of potential impacts, by resource, predicted to occur as a result of alternatives to the Proposed Action.

Alternative A – Eliminate Canal Portion of Water Discharge Pipeline System

Impacts on the following resources from implementation of Alternative A would be similar to those described under the Proposed Action:

- Geology and Minerals;
- Paleontological Resources;
- Air Quality;
- Water Quantity and Quality;
- Soils;
- Vegetation;
- Invasive, Nonnative Species;
- Wetlands/Riparian Zones;
- Fisheries and Aquatic Resources;
- Grazing Management;
- Recreation and Wilderness;
- Access and Land Use;
- Noise;
- Visual Resources;
- Cultural Resources;
- Native American Religious Concerns;
- Social and Economic Resources; and
- Environmental Justice.

Terrestrial Wildlife

Implementation of Alternative A would reduce the potential impacts to terrestrial wildlife by eliminating the physical hazard associated with the open canal system.

Alternative B – Backfill Shafts

Impacts on the following resources from implementation of Alternative B would be similar to those described under the Proposed Action:

- Geology and Minerals;
- Paleontological Resources;
- Air Quality;
- Soils;
- Vegetation;
- Invasive, Nonnative Species;
- Terrestrial Wildlife;
- Wetlands/Riparian Zones;
- Fisheries and Aquatic Resources;
- Threatened, Endangered, Candidate, and Sensitive Species;
- Grazing Management;
- Recreation and Wilderness;
- Access and Land Use;
- Noise;
- Visual Resources;
- Cultural Resources;
- Native American Religious Concerns;
- Social and Economic Resources; and
- Environmental Justice.

Water Quantity and Quality

Groundwater quality within and surrounding backfilled mine shafts could have increased, short-term impacts resulting from contact with the backfill material.

Alternative C – Relocate Waste Rock Disposal Facility and Refractory Ore Stockpile

Impacts on the following resources resulting from implementation of Alternative C would be similar to those described under the Proposed Action:

- Geology and Minerals;
- Air Quality;
- Water Quantity and Quality;
- Terrestrial Wildlife;
- Wetlands/Riparian Zones;
- Fisheries and Aquatic Resources;
- Threatened, Endangered, Candidate, and Sensitive Species;
- Grazing Management;
- Recreation and Wilderness;
- Access and Land Use;
- Noise;
- Visual Resources;
- Cultural Resources;
- Native American Religious Concerns;
- Social and Economic Resources; and
- Environmental Justice.

Paleontological Resources, Soils, Vegetation, and Invasive, Nonnative Species

Under Alternative C, impacts to these resources would be reduced commensurate with 118 acres less new surface disturbance.

No Action Alternative

Under the No Action Alternative, Newmont would not be authorized to develop defined ore reserves, construct ancillary mine facilities, place waste rock in the disposal facility, or construct the dewatering system discharge pipeline on public land. Potential impacts predicted to result from development of the Project would not be realized.

CHAPTER 1

INTRODUCTION

The Elko Field Office of the United States Department of the Interior (USDI) Bureau of Land Management (BLM) received a Plan of Operations from the Newmont Gold Company and Barrick HD Venture in April 1997 proposing development and operation of an underground mine and associated surface support facilities in the Leeville Project area. Since 1997, Newmont has acquired Barrick's interest in the Project and Newmont Gold Company has become Newmont Mining Corporation (Newmont). Newmont has assumed all responsibilities associated with the Plan of Operations as submitted in April 1997 (Newmont 1997a). The Leeville Project area is located on public and private land in Eureka County, Nevada, approximately 20 miles northwest of Carlin, Nevada (**Figure 1-1**).

Proposed facilities in the Leeville Project area are located on public land administered by BLM; consequently, review and approval of Newmont's Plan of Operation is required by BLM pursuant to Title 43, Code of Federal Regulations, Part 3809 (43 CFR 3809) Surface Management Regu-lations. Due to the potential for the proposed Project to result in significant environmental impacts, BLM determined that an Environmental Impact Statement (EIS) would be necessary, as required by the National Environmental Policy Act of 1969 (NEPA).

BLM is serving as lead agency in preparing this EIS for the proposed Project. This document follows regulations promulgated by the Council on Environmental Quality (CEQ) for implementing procedural provisions of NEPA (40 CFR 1500-1508) and BLM's NEPA Handbook (H-1790-1).

This EIS describes components of, reasonable alternatives to, and environmental consequences of proposed mining and waste rock disposal operations in the Leeville Project area. Chapter 1 describes purpose and need for action, the role of BLM, and public participation in the EIS process. Chapter 2 provides a historical perspective of gold mining in the Leeville Project and Carlin Trend areas, a description of existing mining and mineral exploration operations and the Proposed Action, and Alternatives to the Proposed Action. Chapter 3 describes the existing environment in the Leeville Project area. Chapter 4 details potential direct, indirect, and cumulative effects associated with the Proposed Action and Alternatives, and possible mitigation measures that may be selected to reduce or minimize impacts. Chapter 5 identifies the consultation and coordination with state and federal agencies that occurred during preparation of this EIS and a list of preparers. Chapter 6 contains a list of references cited in developing the EIS.

PURPOSE OF AND NEED FOR ACTION

The purpose of Newmont's proposal is to use the existing mining work force to conduct underground mining on unpatented mining claims and fee land within the Leeville Project area to produce gold from ore reserves contained in multiple ore deposits. Gold is an established commodity with international markets and demand. Uses include jewelry, investments, standard for monetary systems, electronics, and other industrial applications.

AUTHORIZING ACTIONS

A proposal submitted to BLM may be approved only after an environmental analysis is completed as required by NEPA. BLM decision options include approving Newmont's Plan of Operations as submitted, approving alternatives to the Plan of Operations to mitigate environmental impacts, approving the Plan of Operations with stipulations to mitigate environmental impacts, or denying the Plan of Operations. If BLM denies the Plan of Operations, the applicant can modify and resubmit the Plan of Operations to address issues or concerns identified by BLM on the original Plan of Operations.

A substantial portion of Newmont's Leeville Project facilities would be located on public land administered by BLM; such operations must comply with BLM regulations for mining on public land (43 CFR 3809, Surface Management Regu-lations), the Mining and Mineral Policy Act of 1970, and the Federal Land Policy and Manage-ment Act of 1976. These laws recognize the statutory right of mining claim holders to develop federal mineral resources under the General Mining Law of 1872. These laws, however, in combination with other BLM policies (i.e., the Resource Management Plan) also require BLM to analyze proposed mining operations to ensure: 1) adequate provisions are included to prevent undue or unnecessary degradation of public land, 2) measures are included to provide reasonable reclamation of disturbed areas, and 3) proposed operations would comply with other applicable federal, state, and local statutes and regulations.

In addition to BLM, other federal, state, and local agencies have jurisdiction over certain aspects of the Proposed Action. **Table 1-1** provides a com-prehensive listing of agencies and their respective permit/authorizing responsibilities. The primary permits to be obtained by Newmont include a reclamation permit, groundwater appropriation permits, water pollution control permit, air quality operating permit, and a stormwater discharge permit.

In July 2001, the Nevada Regulatory Office of the United States Army Corps of Engineers (USACOE) ruled that creeks in the Boulder Creek drainage, Eureka County, Nevada, were "…not jurisdictional waters of the United States…" and 404 permitting would not be necessary (USACOE 199725359).

Groundwater pumped from the mine dewatering system for the Leeville Project would be dis-charged to the alluvial aquifer system in the Boulder Valley, used for irrigation in the Boulder Valley or, as a last resort, would be discharged under Barrick Goldstrike Mines, Inc. (Barrick) current water discharge permit (NEV 0022675). Discharges made under Barrick's discharge permit would require authorization from the Nevada State Engineer. Barrick would notify the Nevada Division of Environmental Protection (NDEP) in accordance with stipulations of the discharge permit.

The Nevada Division of Environmental Protection (NDEP) bonding requirements for mine reclamation in Nevada are outlined in Nevada Administrative Code (NAC)/Nevada Revised Statute (NRS) 519A Regulations. For BLM, Surface Management Regulations (43 CFR 3809) establishes bonding policy relating to mining and mineral development. In 1990, BLM and NDEP entered into a Memorandum of Understanding (MOU) to coordinate evaluation and approval of reclamation plans, and to determine bond amounts for mining and exploration operations. Estimated costs of reclamation are determined by mining companies using industry guidelines and standards for equipment, material, and Davis-Bacon Wage Rates for labor. These rates are approved by BLM and NDEP in determining the bond amount.

RELATIONSHIP TO BLM AND NON-BLM POLICIES, PLANS, AND PROGRAMS

The Leeville Project Plan of Operations has been reviewed for compliance with BLM policies, plans, and programs. The proposal is in conformance with the minerals decisions in the Record of Decision, Elko Resource Area, Resource Management Plan, approved in March 1987. Through the EIS process, the State of Nevada and Eureka County are evaluating the proposed Leeville Project for conformance with existing land use restrictions and Nevada State regulations.

Figure 1-1 – General Location Map

blank

PUBLIC SCOPING

To allow an early and open process for determining the scope of issues and concerns related to the Proposed Action (40 CFR 1510.7), a public scoping period was provided by BLM. A Notice of Intent to prepare the EIS was published in the Federal Register on August 1, 1997 (NV-010-1990-09). Publication of this notice in the Federal Register initiated a 30-day public scoping period for the Proposed Action that provided for acceptance of comments through September 2, 1997.

BLM mailed a scoping package that included a project summary and maps to individuals and organizations listed on the Elko Field Office mailing list. In addition, the scoping package was distributed at public scoping meetings. The Plan of Operations was provided on request.

Concurrent with these actions, BLM issued a news release to 19 radio stations and news organizations with coverage in the surrounding geographical regions in Nevada, Idaho, California, and Utah.

A public scoping meeting was held by BLM in Elko on August 20, 1997. Separate meetings were held for the Elko and Eureka County Commissioners. Twenty members of the public attending the Elko Scoping meeting did not comment on the Project. Written responses were received from 12 agencies and groups during the public scoping period.

Public and agency comments concerning the Proposed Action are shown in **Table 1-2**. This table also provides references to the sections of this EIS which respond to each issue raised in the comments.

TABLE 1-1
Regulatory Responsibilities

Authorizing Action	Regulatory Agency
Plan of Operations/Rights of Way	Bureau of Land Management (BLM)
National Environmental Policy Act	BLM
National Historic Preservation Act	BLM; Nevada Division of Historic Preservation & Archaeology
Native American Graves Protection & Repatriation Act	BLM
American Indian Religious Freedom Act	BLM
Clean Water Act (Section 404)	United States Army Corps of Engineers (USCOE)
High Explosive License/Permit	United States Bureau of Alcohol, Tobacco, & Firearms
Hydrocarbon Permit	Nevada Division of Environmental Protection (NDEP). Bureau of Mining Regulation and Reclamation
Water Appropriation Permits	Nevada State Engineer
Stormwater Permit	NDEP, Bureau of Water Pollution Control
Air Quality Permit	NDEP, Bureau of Air Quality
Water Pollution Control Permit	NDEP, Bureau of Mining Regulation & Reclamation
Mine Reclamation Permit (and Bonding)	BLM; NDEP, Bureau of Mining Regulation & Reclamation
Solid Waste Disposal Permit	NDEP, Bureau of Waste Management
Potable Water	Nevada Division of Health (NDH), Department of Human Resources
Sewer System Approvals	NDH, NDEP, Bureau of Water Pollution Control
Safety Plan	Mine Safety & Health Administration (MSHA)
Endangered Species Act of 1973	United States Fish & Wildlife Service (USFWS)

TABLE 1-2
Scoping Summary
Leeville Project

Issue	Response
Source	
David J. Farrel, Chief Office of Federal Activities U.S. Environmental Protection Agency Region IX, San Francisco, CA August 1997	
Describe all reasonable alternatives to the Proposed Action.	Chapter 2 – Alternatives
Describe implementation of mitigation measures	Chapter 2 – Mitigation Measures Chapter 4 – All Resources
Describe potential impacts on groundwater and surface water, estimated rates of water produced/consumed by Proposed Action and other related projects.	Chapter 4 – Water Quantity & Quality
Potential effects on groundwater and surface water, springs, seeps, water supply wells, wetlands, vegetation, and wildlife.	Chapter 4 – Water Quantity & Quality Chapter 4 – Vegetation, Wildlife, Soils
Include baseline data from past/current groundwater and surface water quality monitoring and measurement of potentiometric surface at various locations over time in the area of affected environment.	Chapter 3 – Water Quantity & Quality
Describe potential cumulative effects to biologic resources	Chapter 4 – Vegetation; Terrestrial Wildlife; Wetlands/ Riparian Zones; Fisheries and Aquatic Resources; Threatened, Endangered, Candidate, & Sensitive Species
Describe potential cumulative effects of mass loading and increased flows on the Humboldt River, Humboldt Sink, and Rye Patch Reservoir	Chapter 4 – Water Quantity & Quality
Describe cumulative effects of discharges of trace elements such as selenium, arsenic and boron on the Humboldt River and wetlands within the closed hydrographic basin.	Chapter 4 – Water Quantity & Quality
Describe affects on Lahonton cuthroat trout habitat in recharge areas affected by groundwater withdrawals.	Chapter 4 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources
Describe proposed project compliance with state and federal water quality standards.	Chapter 3 – Water Quantity & Quality
Describe potential effects of thermal changes, increased suspended solids, toxicity, salinity, and pH on surface water quality.	Chapter 4 – Water Quantity & Quality
Discuss whether a National Pollution Discharge Elimination System (NPDES) permit would be required for discharge to surface water.	Chapter 3 – Water Quantity & Quality
Discuss project compliance with applicable stormwater permitting requirements.	Chapter 2 – Proposed Action
Describe existing environment in project locale including drainage patterns, hydrologic and topographic maps.	Chapter 3 – Water Quantity & Quality
Discuss effects of the project on erosion potential and sedimentation.	Chapter 4 – Soils
Identify and describe areas within 50 and 100 year floodplains.	Chapter 3 – Water Quantity & Quality
Discuss potential for flash floods to transport sediment from disturbed areas to stream channels.	Chapter 3 – Soils
Describe existing and proposed processing facilities associated with the project.	Chapter 2 – Proposed Action
Discuss potential for surface water contamination infiltrating through tailing disposal facilities, various stockpiles, and waste rock dumps.	Chapter 4 – Water Quantity & Quality
Describe mitigation measures to prevent surface water contamination including construction of run-on/run-off channels, impermeable covers, collection or sedimentation ponds, and any necessary treatment or disposal.	Chapter 4 – Water Quantity & Quality Chapter 4 – Soils
Discuss flow velocities of all discharges to surface water and effect on scouring and sedimentation.	Chapter 4 – Water Quantity & Quality Chapter 4 – Soils
Describe procedures to address accidental releases of hazardous materials, including overflow from ponds.	Chapter 2 – Proposed Action. Note: There are no solution ponds proposed for this project at this site.
Describe potential impacts from failure of solution containment systems and tailing ponds, methods for discovering such failures, and degree to which impacts are reversible.	Comment noted: There are no solution ponds proposed for this project at this site.

TABLE 1-2
Scoping Summary
Leeville Project

Issue	Response
Describe acid generation/neutralization potential for waste rock, stockpiles, tailing, and backfill at the site, and appropriate mitigation measures.	Chapter 2 – Proposed Action Chapter 3 – Geology & Minerals Chapter 4 – Geology & Minerals
Describe applicable tests and results conducted on ore and waste rock, including sample locations.	Chapter 3 – Geology & Minerals Chapter 4 – Geology & Minerals
Describe water quality at older, nearby mining sites that could be used to predict future acid generation at proposed project.	Chapter 3 – Water Quantity & Quality
Describe waste rock characterization and disposal plan	Chapter 2 – Proposed Action
Describe proposed facility design and operation, and maintenance and monitoring activities.	Chapter 2 – Proposed Action
Describe and provide all points of compliance and monitoring wells on the project site, including screening intervals, parameters to be monitored, and monitoring frequencies.	Chapter 3 – Air Quality Chapter 3 – Water Quantity & Quality
Discuss chemical characterization of water in open ponds located at the site.	Chapter 3 – Water Quantity & Quality
Describe potential for and effects of movement of contaminated surface water to subsurface.	Chapter 4 – Water Quantity & Quality
Describe the chemistry of cyanide in water and soil, and the cyanide budget resulting from leach processing at similar mines.	Chapter 4 – Water Quantity & Quality
Estimate quantities of cyanide likely to be "lost" and its fate.	Comment noted: There are no solution ponds proposed for this project at this site.
Discuss applicability of Section 404 Permit under the Clean Water Act	Unites States Army Corps of Engineers has determined that a Section 404 Permit is not required.
Describe potential cumulative impacts to resources, considering the proposed project in the context of past, current, and reasonably foreseeable future mining and other activities in the project vicinity.	Chapter 4 – All Resources
Discuss cumulative impacts to water and air quality, hydrology, soils, vegetation, wildlife, and biodiversity.	Chapter 4 – Respective Resources
Discuss potential impacts, including cumulative impacts, to threatened, endangered, candidate, and sensitive plant and wildlife species.	Chapter 4 – Threatened, Endangered, Candidate, and Sensitive Species
Discuss mitigation measures to prevent exposure of migratory waterfowl and other wildlife to toxic water used in processing ore.	Comment noted: There are no solution ponds proposed for this project at this site.
Netting and scare tactics are not completely reliable prevention measures and serious consideration should be given to covering any pregnant solution ponds on the project site.	Comment noted. There are no pregnant solution ponds proposed for this project at this site.
Identify and discuss wetland and riparian habitats and other unique or important habitat areas affected by the project.	Chapter 3 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources
Discuss avoidance, minimization, and mitigation of losses or modification of habitat and plant and animal composition.	Chapter 4 – Respective Resources
Describe mitigation plan for replacement of habitat adversely affected by the project.	Chapter4 – Mitigation and Monitoring Measures for All Resources
Discuss National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments applicable to air quality in the project area.	Chapter 3 – Air Quality
Discuss impacts to NAAQS and PSD increments from estimated emissions from all aspects of mine excavation, construction, operation, and support activities such as vehicle traffic.	Chapter 4 – Air Quality
Discuss mitigation measures necessary to comply with NAAQS and PSD.	Chapter 4 – Air Quality
Identify any Class I PSD areas within 100 kilometers of the proposed project.	There are no Class I PSD areas within 100 kilometers of the proposed project.
Discuss applicability and requirements of the New Source Performance Standards for Metallic Mineral Processing Plants.	Chapter 2 – Proposed Action
Describe applicability and compliance with State Implementation Plan (SIP).	Chapter 3 – Air Quality
Describe air quality monitoring plan to assure compliance with applicable air quality standards.	Chapter 3 – Air Quality
Describe applicability and compliance with Resource Conservation and Recovery Act regulations.	Chapter 2 – Proposed Action

TABLE 1-2
Scoping Summary
Leeville Project

Issue	Response
Describe procedures to decommission mine operations, and neutralize or cap waste rock, tailing, and leach heaps.	Chapter 2 – Proposed Action
Identify areas targeted for reclamation and the degree of treatment and any irrigation requirements proposed.	Chapter 2 – Proposed Action
Describe reclamation schedule and duration.	Chapter 2 – Proposed Action
Describe standards for determining and means of assuring successful reclamation.	Chapter 2 – Proposed Action
Describe means of assuring any maintenance required for reclaimed areas would continue after operations cease or are suspended.	Chapter 2 – Proposed Action
EPA recommends BLM require revegetation of disturbed areas be accomplished with only native species indigenous to the area and that revegetation success be monitored and enforced for at least five years following revegetation efforts..	Comment noted.
Discuss provisions for post-operation surveillance to ensure neutralization and/or stabilization of mining waste has been effective.	Chapter 2 – Proposed Action
Describe mitigation actions that would be taken should destabilization or contamination be detected and identify responsible party.	Chapter 2 – Proposed Action
Specify bonding requirements to ensure reclamation should the mining company fail to carry out all required reclamation activities and identify responsible party for post-closure cleanup actions.	Chapter 1 – Authorizing Actions
Describe measures taken by BLM to fully analyze environmental effects of the proposed federal action on minority communities and low-income populations, and present opportunities for affected communities to provide input in the NEPA process.	Chapter 3 – Environmental Justice
The EIS should state whether the analysis meets requirements of BLM's environmental justice strategy.	Chapter 3 – Environmental Justice
Describe efforts by BLM to enter into government to government consultations with potentially affected Tribes	Chapter 3 – Environmental Justice
Discuss impacts to livestock grazing in the project vicinity	Chapter 4 – Grazing Management
Discuss whether reduction in forage would necessitate a reduction in livestock grazing in the area for the duration of the project to prevent overgrazing.	Chapter 4 – Grazing Management
Identify potential impacts to other special uses that would be displaced by the Proposed Action.	Chapter 4 – Respective Resources
Describe Toxic Release Inventory Reporting requirements of Section 313 of the Emergency Planning and Community Right-to-know Act.	Chapter 2 – Proposed Action
Source	
Jeanen C. Hafen **Northern Nevada Project Director** **Nature Conservancy of Nevada** **Reno, NV** **August 1997**	
Describe how this project and others in the area would impact surface water in the area.	Chapter 4 – Water Quantity & Quality
Describe impacts of dewatering water to the Humboldt River.	Chapter 4 – Water Quantity & Quality
Describe the impact of this project to restoration of the Argenta Marsh	Chapter 4 – Wetlands/Riparian Zones & Fisheries and Aquatic Resources
Describe cumulative impacts of dewatering and displacement of water.	Chapter 4 – Water Quantity & Quality

TABLE 1-2
Scoping Summary
Leeville Project

Issue	Response
Source	
David P. Overvold Acting Area Manager USDI Bureau of Reclamation Carson City, NV August 1997	
Describe amount and quality of drainage water draining to Humboldt River.	Chapter 3 – Water Quantity & Quality
Describe impacts to the Battle Mountain Pasture	Chapter 4 – Grazing Management
Source	
James Morefield Nevada Natural Heritage Program Carson City, NV August 1997	
Describe impacts to riparian corridors, and all known and undocumented populations of threatened, endangered, candidate, and sensitive species.	Chapter 4 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources Chapter 4 – Threatened, Endangered, Candidate, & Sensitive Species
Encourage use of native species in reclamation	Comment noted.
Source	
Michael J. Anderson, P.E. Nevada Department of Water Resources Carson City, NV August 1997	
Will existing tailing facilities have adequate capacity to handle additional slimes?	Chapter 2 – Proposed Action
Do operators have sufficient water rights to pump the anticipated 78 cfs initially and 44.6 cfs over the life-of-mine and continue operation of other pits/deeprock projects currently under development?	Chapter 2 – Proposed Action
What will be resident capacity of cooling facilities holding ponds?	Chapter 2 – Proposed Action
How much water will be lost to evaporation?	Chapter 2 – Proposed Action
How much water is anticipated to be used beneficially for irrigation, processing and general mine use?	Chapter 2 – Proposed Action
Source	
Bill Durbin, Geologist Nevada Department of Business and Industry Division of Minerals Carson City, NV August 1997	
Describe methods and technology employed for closure and securing mine openings on completion of mining.	Chapter 2 – Proposed Action
Source	
David M. Buhlig Senior Land Use Specialist Sierra Pacific Power Company Reno, NV August 1997	
Production and ventilation facilities are proposed for construction beneath a permitted 120 kV powerline (BLM #N-47775), the 148 Line – Maggie Creek to Boulder Basin Sub. Relocation of powerline will be required. Cost of relocation to be borne by applicant (Newmont)	Comment noted.

TABLE 1-2
Scoping Summary
Leeville Project

Issue	Response
Source	
Bennie B. Hodges Secretary/Manager Pershing County Water Conservation District of Nevada Lovelock, NV September 1997	
Describe increased amount of mine dewatering water discharged to Humboldt River that could causing flooding of 5,000 acres in south portion of District.	Chapter 3 – Water Quantity & Quality
With Humboldt Sink full and Rye Patch Reservoir at 91% capacity increased flows from mine dewatering will cause flooding and blocking drains from Nile Valley in Lovelock.	Chapter 4 – Water Quantity & Quality
Source	
Chester C. Buchanan, Acting State Supervisor USDI, Fish & Wildlife Service Reno, NV August 1997	
Evaluate impacts to threatened, endangered, candidate, and sensitive species.	Chapter 4 – Threatened, Endangered, Candidate, & Sensitive Species
Cumulative impact analyses should evaluate and quantify, where possible, all federal and non-federal past, present, and future actions which may affect the same resources potentially impacted by the proposed action.	Chapter 4 – All Resources
Describe cumulative impacts of surface disturbance in Carlin Trend, and the Humboldt River, Humboldt Sink, and all tributaries influenced by dewatering and associated activities in the Carlin Trend.	Chapter 4 – Cumulative Impacts Chapter 4 – Water Quantity & Quality
Describe positive and negative impacts , either direct, indirect, or cumulative, to terrestrial and aquatic wildlife and habitats for each alternative.	Chapter 4 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources Chapter 4 – Terrestrial Wildlife
Recommend all land clearing activities be conducted outside of the avian breeding season.	Comment noted.
Wetland and riparian communities should be identified and whether a Section 404 permit will be required.	Chapter 3 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources United States Army Corps of Engineers has determined a Section 404 permit is not required.
Describe impacts to water quality for each alternative including surface and groundwater, increased erosion and sediment loads to streams, and groundwater supplies and potential for depletion which may affect wildlife resources and wetlands.	Chapter 4 – Water Quantity & Quality Chapter 4 – Terrestrial Wildlife Chapter 4 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources Chapter 4 – Vegetation
Describe techniques and assumptions used to model the cone of depression in dewatered areas including a map.	Chapter 4 – Water Quantity & Quality
Describe the area likely to be affected directly and indirectly by groundwater recharge following mine closure including a map.	Chapter 4 – Water Quantity & Quality
Discuss time required to recharge underground aquifers and achieve equilibrium throughout the system.	Chapter 4 – Water Quantity & Quality
Impacts to soil quality for each alternative should be addressed.	Chapter 4 – Soil
Describe impacts to air quality from particulate and dust emissions from mining, ore processing, and fugitive dust from loss of vegetative cover.	Chapter 4 – Air Quality
Potential impacts of hazardous materials used or produced at the site to fish and wildlife should be discussed.	Chapter 2 – Proposed Action Chapter 4 – Terrestrial Wildlife
Identify transportation routes for hazardous materials and any threatened, endangered, candidate, or sensitive species which may occur along these routes.	Chapter 2 – Proposed Action
Location and qualification of personnel responding to accidents involving hazardous materials.	Chapter 2 – Proposed Action
Describe impacts of noise from mining operation on wildlife	Chapter 4 – Noise

TABLE 1-2 Scoping Summary Leeville Project	
Issue	**Response**
Describe measures to avoid, reduce, or compensate for direct and indirect habitat losses to fish and wildlife resulting from this project.	Chapter 4 – Terrestrial Wildlife Chapter 4 – Wetlands/Riparian Zones; Fisheries and Aquatic Resources
The EIS should discuss mitigation/compensation measures in detail, including reclamation plans for the site.	Chapter 2 – Proposed Action
Describe monitoring levels and parameters that would be implemented for life-of-mine and for whatever timeframe indirect impacts are likely to occur.	Chapter 4 – Respective Resources
A mechanism to ensure implementation of additional mitigation/compensation measures should be provided in the event monitoring shows higher levels of adverse impacts than originally anticipated.	Comment noted.
Monitoring should be provided to ensure success of any mitigation developed for the project.	Comment noted.
Source	
Thomas J. Fronapfel, P.E. Nevada Department of Transportation Carson City, NV September 1997	
Perform traffic study to determine additional impact project would have and if State Route 766 needs to be widened as a result.	Chapter 2 – Proposed Action
Source	
Patrick Reardon Butte, MT August 1997	
Mining is a benefit to the nation's economy and to local environment as well.	Comment noted.
Source	
Tom Meyers, Ph.D Hydrologic Consultant Reno, NV September 1997	
Describe overall cumulative impacts of dewatering to Humboldt River.	Chapter 4 – Water Quantity & Quality

CHAPTER 2

DESCRIPTION OF PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

This chapter describes Newmont's previous operations at the Leeville Project area, Newmont's Proposed Action to develop the Leeville Mine, and a range of reasonable alternatives to the Proposed Action. The proposal to develop ore reserves in multiple deposits located in the Leeville Project area is collectively referred to as the Leeville Project or the Proposed Action in this document.

Alternatives considered in the EIS are based on issues identified by the BLM and comments received during the public scoping process. Alternatives are developed in response to substantive issues identified during scoping and are intended to reduce or minimize potential impacts associated with the Proposed Action that are not being mitigated by Newmont (Chapter 2) or BLM (Chapter 4).

Detailed discussions of the following topics are presented in this chapter:

- History of mineral exploration and mining in the Carlin Trend and Leeville Project area;
- Newmont's previous activities in the Leeville Project area;
- Newmont's Proposed Action for the Leeville Project; and
- Alternatives to the Proposed Action, including the No Action Alternative and Alternatives Considered but Eliminated from Detailed Analysis.

HISTORY OF EXPLORATION AND MINING

The area of gold mine development in the vicinity of Carlin, Nevada is known as the Carlin Trend (**Figure 2-1**). The Carlin Trend is a linear sequence of gold deposits extending from approximately 10 miles southeast to approximately 40 miles northwest of Carlin. Although the area has been mined for the past 120 years, major mining activity began with development of the Carlin Pit in 1965.

GOLD MINERALIZATION

The following primary geologic occurrences have led to present-day gold mining in the Carlin Trend: 1) deposition and lithification of marine sediments that host the gold mineralization; 2) faulting that disrupted these rocks and created pathways for movement of mineralizing fluids and openings for deposition of gold; 3) deposition of gold from mineralizing fluids associated with igneous activity; and 4) surface erosion that exposed the mineralized rocks.

As gold-bearing fluids migrated upward along faults and fractures, they permeated the disrupted rocks throughout the area. This resulted in widespread dissemination of gold particles and sulfide minerals through large volumes of rock, creating large-tonnage, low-grade gold deposits known to geologists as "Carlin-type" ore bodies. Disseminated gold deposits are typically composed of submicron-sized gold particles often visible only with a scanning electron microscope. Over 20 ore deposits have been identified in the Carlin Trend since exploration for disseminated gold was initiated.

Geologic and mineralization processes have resulted in formation of two disseminated ore types in the Carlin Trend. The uppermost or near-surface ore type is known as oxide ore. This type of ore occurs at shallow depths where oxygenated water percolating through the subsurface has leached most sulfide minerals from the rock. The natural leaching process leaves gold in the rock but removes most of the sulfidic minerals.

A second ore type is unoxidized and typically occurs at greater depths at or below the water table where water is low in oxygen. Unoxidized ore is commonly rich in sulfides and can be refractory (i.e., difficult to treat for recovery of precious metals). Refractory ore is further broken down into two subclassifications: 1) silica-sulfide ore, in which gold is locked within sulfide and quartz minerals; and 2) carbon-sulfide ore, in which gold occurs with carbonaceous and sulfidic minerals. Refractory ore is not readily amenable to gold extraction through conventional cyanide leaching; additional processing is required to recover the gold.

MINING IN THE CARLIN TREND

Exploration activities in the Carlin Trend began in the early 1870s with staking of the Good Hope claims in the Maggie Creek district (Coope 1991). These claims produced mainly lead and silver, with minor amounts of barite and gold. The first significant gold discovery was made on Lynn Creek in 1907, approximately 1.5 miles north of the present Carlin Mine. Placer gold discoveries followed in Sheep, Rodeo, and Simon creeks (**Figure 2-1**).

Newmont initiated its mining activities in the North Operations Area at the Carlin open-pit mine in 1965. Newmont's North Operations Area includes all of Newmont's mining operations located between the Carlin and Bootstrap Mines. Mining at the Bootstrap open-pit mine began in 1974 and continued until 1984; closure and reclamation activities were completed in 1988. Newmont began mining at Blue Star in 1974, and at Genesis in 1986. In 1988, Newmont constructed and initiated operations at the Mill #4 process facilities and North Area Leach Facilities. In 1994, Newmont re-initiated mining at the Bootstrap open-pit mine, including the Capstone and Tara open-pit mines.

From 1979 to 1982, the Bullion Monarch open-pit mine was operated by Universal Gas. Process facilities for this operation consisted of a mill and associated tailing impoundment. The mill facilities at this site were demolished during 1992 and 1993. The Bullion Monarch open-pit and mill facilities were located in the W½, Section 10, T35N, R50E. The proposed Leeville Project will encompass a portion of the area previously disturbed by the Bullion Monarch Mine Project.

Polar Resources began mining operations at the Betze/Post Mine in 1974; after several different owners this mine was acquired by American Barrick Resources in 1986 and subsequently became the Betze/Post open pit mine (McFarlane 1991a). Barrick began development of the Meikle underground mine in 1995, with processing occurring at the Betze/Post operations.

In 1992, Newmont began exploration on the High Desert (also known as HD Venture) Exploration Project, located in Sections 2, 10, 11, and 12, T35N, R50E and Section 18, T35N, R51E. In 1993, Newmont began exploration on the Chevas Exploration Project, located in sections 1, 2, and 3, T35N, R50E and Section 7, T35N, R51E. Exploration activities within these two projects consisted of mapping, drilling, and trenching.

ORE PROCESSING IN THE CARLIN TREND

Newmont and Barrick operate open-pit and underground mines and process ore using both milling and heap leach facilities in Eureka and Elko counties in the Carlin Trend. Newmont mines and facilities are at the following locations: Rain Operations Area approximately 10 miles southeast of Carlin; South Operations Area 6 miles northwest of Carlin; and North Operations Area approximately 20 miles northwest of Carlin. Barrick's operations include the Betze/Post Mine located adjacent to Newmont's North Operations Area, and the Meikle Mine located immediately north of Betze/Post Mine.

Figure 2-1

blank

Early ore processing in the Carlin Trend relied on milling and vat leaching to recover gold from high-grade ore. Vat leaching involves grinding rock to a fine sandy texture (milling) and mixing the ground rock with cyanide solution in tanks for removal of gold (vat leaching). Oxidized ore low in carbon could be directly leached, while unoxidized carbonaceous ore was treated with chlorine prior to extraction. Milling methods continue to be economically viable for richer ores, but are generally not cost-effective for low-grade deposits.

Development of heap leaching for gold recovery from low-grade oxide ore began in the 1970s, allowing further expansion of the regional mining industry. Heap leaching involves placing low-grade oxide ore in large heaps and sprinkling the heaps with a weak cyanide solution. The cyanide solution percolates through the heaps, dissolving gold from the ore. The heaps are lined with impervious materials and are designed to channel gold-bearing solution to holding ponds. Gold is removed from the cyanide solution by adsorption to carbon. The carbon is processed to remove the gold and then the gold is shipped to specialty refiners for further refinement.

The effectiveness of cyanide leaching is decreased by presence of carbonaceous material or sulfide in the ore. Sulfide selectively absorbs the cyanide and can encapsulate gold particles. Natural carbon in the ore adsorbs the gold from the cyanide solution. For this reason, mining in the Carlin Trend during the early 1980s focused on near-surface oxidized rock that is amenable to heap leaching. Deeper ores containing sulfide or carbonaceous material require milling and refractory ore processing, which is more expensive than heap leaching. In early 1971, Newmont installed a 500-ton per day chlorine circuit in the mill for oxidizing high-grade carbonaceous ore. Limited mining and stockpiling of deeper sulfidic occurred in the mid- to late 1980s.

In the late 1980s, as new processes were being developed to treat refractory ores in the Carlin Trend, geologists discovered relatively rich gold deposits at greater depth where oxidation of sulfide minerals had not taken place. Geologically, these deep-sulfide refractory ores typically occur in feeder zones through which original mineralizing fluids migrated to permeate upper host rocks. These deep feeder zones typically have a richer gold content than the near-surface ore, but lie below the depth of natural oxidation. Extraction of this ore often requires mining below the water table.

In recent years, techniques have been developed to economically recover gold from both sulfide and sulfidic-carbonaceous refractory ores. Refractory processing methods involve artificially oxidizing the sulfide and carbonaceous material in the ore prior to conventional cyanide extraction. Artificial oxidation is accomplished by heating ore in an oxygen-rich environment (roasting) or adding high pressure to the roasting process (autoclave). Because both of these methods require large amounts of electrical or gas energy, efforts are underway to develop biological or less expensive chemical processes to oxidize the ore. Newmont's bioleach processing facilities are located at the South Operations Area. Presently, however, thermal methods are the only ones used for processing refractory ores in the Carlin Trend. Once the ore has been oxidized, gold is recovered through cyanide extraction.

PREVIOUS AND CURRENT OPERATIONS

LOCATION AND LAND OWNERSHIP

The Leeville Project area lies on the western flank of the Tuscarora Mountains within the Little Boulder Basin in Sections 2, 10, and 11, T35N, R50E. As part of the Proposed Action for the Leeville Project, a water pipeline would be located in Sections 8, 10, 15, 16, and 17, T35N, R50E; Sections 1, 2, 3, and 12, T35N, R49E. Mining claims affected by this project are contained in the Plan of Operations on file at the BLM Field Office in Elko, Nevada.

Previous exploration activities in the Leeville Project area include construction of access roads, drill sites; excavation of trenches and test pits; and installation of test wells and piezometers. Geologic evaluations (exploration activities) are authorized under two exploration plans within the Leeville Project area boundary: the High Desert Exploration Plan of Operations (N16-92-003P) and the Chevas Exploration Plan of Operations (N16-93-002P). Newmont is authorized to disturb 164 acres within the High Desert Exploration Project area boundary and 168 acres within the Chevas Exploration Project area boundary.

Figure 2-2 depicts surface and mineral ownership of land within the Leeville Project area. Existing right-of-way (ROW) easements, also shown on the figure, are discussed in Chapter 3, *Access and Land Use*. **Figure 2-3** shows disturbance in the Leeville Project area associated with exploration operations.

PROPOSED ACTION

In April 1997, Newmont submitted a proposed Plan of Operations (POO) for the Leeville Project to the BLM. The POO includes description of the following proposed activities:

- Developing and operating the Leeville underground mine;
- Constructing a waste rock disposal facility;
- Developing refractory ore stockpiles;
- Shipping ore to Newmont's Mill 6 in the South Operations Area;
- Rerouting and upgrading existing access road to a haul road;
- Constructing a water treatment facility to treat mine discharge water;
- Constructing a pipeline and canal system to deliver water from the Leeville Project dewatering well network to the Boulder Valley infiltration/irrigation system;
- Constructing ancillary facilities;
- Continuing geologic evaluations and exploration activities;
- Rerouting the existing Sierra-Pacific power line; and
- Reclaiming of areas disturbed by activities described above.

The location of the Project in relation to adjacent mining operations is shown on **Figure 2-1**. Total area of proposed disturbance for the Leeville Project would be approximately 486 acres, including 453 acres of public land and 33 acres of private land. The proposed disturbance area encompasses 80 acres of existing disturbance associated with exploration activity at Leeville.

Proposed disturbance areas and acres of disturbance are shown on **Figure 2-4** and in **Table 2-1**. Under current operating plans and projections, Newmont anticipates the Leeville Project to have a mine life of 18 years. A schematic drawing which delineates primary components of the proposed mining and processing systems is shown on **Figure 2-5**.

These components of Newmont's Plan of Operations for the Leeville Project constitute the Proposed Action analyzed in this EIS. Reference to the Proposed Action throughout the EIS will mean Newmont's Plan of Operations.

MINING OPERATIONS

Newmont proposes to remove ore and waste rock from multiple underground ore deposits identified as West Leeville, Four Corners, and Turf. Five shafts (four ventilation and one production) would be constructed to support underground mining for production, underground access, and ventilation. Ore and waste rock totaling 18 million tons would be excavated using conventional underground mining methods. Thick, competent ore zones would be mined by longhole stoping with delayed backfill; thinner and/or less competent ore zones would be mined using underhand drift and fill stoping techniques.

Ore and waste rock would be drilled and blasted in stopes and transported via a series of horizontal haulage ways interconnected by ramps. Horizontal haulage ways would connect to the central production shaft where ore and waste rock would be hoisted to the surface. Loading and haulage of ore and waste rock in the underground operation would be by diesel-powered, rubber-tired mining equipment.

Most mined-out stopes would be backfilled with cemented rock fill consisting of aggregate and cement mixtures. When necessary, suitable aggregate material from other mine areas or quarries on private land would be obtained to provide high-strength cemented backfill for stopes. These materials would be transferred from a surface stockpile (**Figure 2-4**) to a mixing plant located underground. Potential sources of aggregate material to be used for backfill include Barrick's Betze/Post pit and Newmont's Genesis, Blue Star, Lantern, and Bootstrap pits and other as yet to be identified sources located on private land. After mixing

Figure 2-2

blank

Figure 2-3

Blank

Figure 2-4

Blank

Figure 2-5

Blank

TABLE 2-1
Proposed Disturbance in the Leeville Project Area

Proposed Action	Public Land (acres)	Private Land (acres)	Total Land (acres)
Surface Support Facilities	208	0	208
Waste Rock Disposal Facility	57	0	57
Haul Roads	38	0	38
Geologic Evaluations	40	10	50
Refractory Ore Stockpile	61	0	61
Backfill Stockpile	42	0	42
Topsoil	17	0	17
Mine Dewatering System Pipeline/Canal	23	23	46
Mine Dewatering System Ancillary Facilities	47	0	47
Existing Geologic Evaluations[1]	(80)	(0)	(80)
Total Proposed Disturbance	**453**	**33**	**486**

[1]The 80 acres of disturbance associated with the existing geological evaluations are included within the proposed disturbance for surface support facilities, waste rock disposal facilities, and roads.
Source: Newmont 1997a.

aggregate and cement, the mixture would be transported to mined-out stopes. Development waste rock would also be used for stope backfill whenever possible. Waste rock transported to the surface disposal facility would not be returned underground for use as backfill. The engineering properties of this material are not suitable for use in preparing a high-strength cemented backfill.

The Leeville Project ore deposits consist of refractory material that would be hauled directly to processing facilities located at the Refractory Ore Treatment Plant at Newmont's South Operations Area **(Figure 2-6)** or would be temporarily placed in a refractory ore stockpile located in Section 10, T35N, R50E (**Figure 2-4).** Approximately 18 million tons of ore and waste rock would be removed over an 18-year mine life. Projected production rates for the Leeville Project are shown in **Table 2-2.**

Construction of five mine shafts (one production shaft and four ventilation shafts) and surface support facilities at the Leeville Project would disturb 208 acres of public land in Sections 2, 10 and 11, T35N, R50E (**Figure 2-4**). Precise dimensions of mine shafts have not been finalized; however, in general, the production shaft may range from 20 to 26 feet in diameter and the West Leeville ventilation shaft may be 14 to 20 feet in diameter. Other ventilation shafts may be 13 feet in diameter. Shafts would extend 2,500 feet below existing ground surface.

Shaft construction would be initiated with construction of a shaft collar. The first 85 to 100-feet below ground surface would be excavated using standard construction equipment. Concrete forms set inside the excavation temporarily support shaft collar excavation. Concrete is then poured to form the shaft collar and lining. After the concrete has cured, work decks for shaft sinking are lowered into the collar structure and a temporary bulkhead placed over the collar. Head frames and hoisting plants are constructed over the shafts and shaft-sinking equipment installed.

Shaft sinking at the Leeville Project would be performed using conventional drill and blast methods. This type of shaft sinking is a cyclical process where the shaft is constructed incrementally. Elements of the cycle include drilling, blasting, mucking, and installation of temporary ground support and shaft lining (concrete liner) to control ground movement. The concrete shaft liner installed in each shaft would be designed to prevent seepage into the shafts. Steel sets would be installed to provide a structural framework for the hoisting system. Blast holes are drilled vertically into the shaft bottom to depths ranging 8 to 10 feet. Blast holes are loaded with explosives and detonated. Broken rock resulting from the blast is loaded into large buckets and hoisted to the surface. Rock bolts and wire mesh are installed on shaft walls to provide temporary ground support. Circular concrete forms are lowered to within a few feet of the shaft bottom and temporarily set. Concrete is poured behind the forms to form the shaft liner. If ground conditions are relatively stable, two or more cycles of drilling, blasting,

TABLE 2-2
Projected Leeville Mine Production

Year	Waste Rock (tons)	Ore (tons)	Total (tons)
1	33,000	0	33,000
2	134,000	0	134,000
3	300,000	0	300,000
4	221,000	0	221,000
5	202,000	0	202,000
6	492,000	374,000	866,000
7	533,000	785,000	1,318,000
8	252,000	1,344,000	1,596,000
9	266,000	1,513,000	1,779,000
10	227,000	1,573,000	1,800,000
11	231,000	1,568,000	1,799,000
12	296,000	1,466,000	1,762,000
13	221,000	1,408,000	1,629,000
14	262,000	1,408,000	1,670,000
15	132,000	1,180,000	1,312,000
16	135,000	881,000	1,016,000
17	30,000	372,000	402,000
18	17,000	209,000	226,000
Total	**3,984,000**	**14,081,000**	**18,065,000**

Source: Newmont 1997a.

and mucking may be completed before advancing the concrete lining. After the concrete shaft liner has cured sufficiently, utility lines and structural steel required for hoisting would be installed. After installation of utility lines, another cycle of shaft sinking can be undertaken.

If large volumes of water are encountered during shaft sinking pressure grouting would be used to seal rock fractures. Once groundwater inflow is controlled shaft sinking would resume as described above.

Construction of the collar, headframe, and hoisting plant and installation of shaft-sinking equipment is expected to require 7 months for the production shaft and 5 months for ventilation shafts. Average shaft-sinking rate for production and ventilation shafts is expected to be 5 to 6 feet per day. The production shaft is expected to require 11 months to complete; ventilation shafts would require about 8 to 9 months for completion. After shaft sinking has been completed, excavation and construction of shaft stations and facilities for storage and loading of ore and waste rock, electrical power distribution, and pumping would occur. Shaft station construction and installation of equipment is expected to require 2 to 3 months for ventilation shafts and 8 months for the production shaft.

MINE DEWATERING

Ore deposits at the Leeville Project lie below the water table which is at a current elevation of approximately 5,700 feet above mean sea level (AMSL) in the upper plate (siltstone) and about 4,900 feet AMSL in the lower plate (carbonate) (Newmont 2000; 2001). Dewatering activities presently underway at the Goldstrike Property (includes Barrick's Betze/Post open pit mine and Meikle underground mine) and Gold Quarry mines are lowering the regional water table in the Project area. Additional dewatering wells would be needed to lower groundwater levels sufficiently for the Leeville Project to proceed. Initially, Newmont proposes to install eight dewatering wells in the upper plate and seven wells in the lower plate. Drill pads constructed for wells would be 50 feet by 85 feet. Up to 35 dewatering wells could be necessary to lower groundwater to an approximate elevation of 3,800 feet AMSL in the lower plate. Localized water that is not intercepted by the network of dewatering wells and enters the mine workings would be routed to one or more central sumps for removal from the mine.

Newmont's current dewatering plan requires pumping wells completed in groundwater in the upper plate during sinking of all five shafts. Pumping from these wells would be suspended once shaft construction has sufficiently

Figure 2-6

blank

advanced. The groundwater system in the upper plate (siltstone) would then be allowed to recover while pumping continues from lower plate wells (carbonate). Lower plate wells would dewater the lower bedrock unit, including the ore zone.

Should groundwater inflow to shafts occur during construction in volumes that impede shaft sinking activity, pressure grouting techniques would be used in the upper plate rocks to seal fractures and reduce inflow. This technique may be used if excessive groundwater inflows are encountered during underground development and mining.

Estimated average groundwater pumping rates for the Leeville Project are presented in **Table 2-3,** and are based on predictions developed using a geologically-based, three-dimensional finite element hydrologic computer model of the Leeville Project and other mines in the Carlin Trend. The model was developed in the context of other area mines and was used to determine groundwater dewatering rates required in the Leeville Project area.

As shown in **Table 2-3**, the maximum pumping rate of 25,000 gallons per minute (gpm) is expected to occur in years 1-2. Once ground-water levels are depressed, pumping rates can be reduced to 6,000 to 9,000 gpm to maintain the desired groundwater level (years 5-18).

A mine water sump would be constructed on the surface consisting of two reinforced concrete silting basins equipped with weirs, oily water collection basins, oil skimmers, and waste oil collection tanks. Mine water would come into contact with mine machinery where oil and grease could be released into the water. Each basin would be approximately 125 feet long, 120 feet wide, 5 feet deep, and have a capacity of 350,000 gallons. A dam permit would not be required for the mine water sump. The water would be treated for hydrocarbon removal and used for dust control at the mine.

Mine water may also be used for production and dust control at the Project area. Production requirements for the Leeville Project would vary throughout the year, but would not consume enough water to eliminate the need for discharge. Excess groundwater remaining after production and dust control requirements have been met would be used for 1) irrigation in the Boulder Valley during the appropriate season and, 2) discharged to infiltration basins (including the TS Ranch Reservoir) during non-irrigation periods. Should conditions arise where Newmont could not effectively discharge water using these systems or find other locations where infiltration would accommodate the volume of water, Newmont would seek to directly discharge to the Humboldt River via the Boulder Valley conveyance system under discharge permit NEV0022675. This permit was issued to Barrick by Nevada Division of Environmental Protection (NDEP) with a provision that other mines in the area be allowed to use this permitted outfall. Discharge would not be allowed to the Humboldt River unless authorized by the State Engineer and only if the excess water cannot be removed via infiltration, injection, and/or irrigation.

Used potable water (e.g., shower water and sewage) would flow to a septic system. The septic system would be located a minimum 150-feet from a stream channel and outside the 50-year floodplain. The location of the septic system is shown on **Figure 2-4**.

Water Treatment

Newmont would construct a water treatment facility to treat groundwater pumped from the mine dewatering well system. The water treatment plant would use chemical precipitation to reduce arsenic concentrations and any other parameters to meet state standards prior to conveyance in the discharge pipeline system. Sludge generated from the water treatment facility would be transported by truck to Mill 4 Tailing Disposal Facility located in the North Operations Area for disposal.

Should groundwater be discharged to the Humboldt River under Barrick’s discharge permit, the water would require cooling to meet discharge temperature requirements. Newmont would use Barrick’s cooling towers to reduce the temperature of discharge water to meet State of Nevada water quality standards (**Figure 2-7**).

Water Discharge Pipeline/Canal System

Groundwater would be transported from dewatering wells located at Leeville to Barrick's cooling canal, located about 5.5 miles west of Leeville, through a gravity-fed, 42-inch diameter pipeline and canal. **Figure 2-7** shows the proposed route of the pipeline and canal for the Leeville Project dewatering system. The pipeline would be buried, except in rocky areas where it would be located on the surface.

TABLE 2-3
Dewatering Rates – Leeville Project

Years After Start of Dewatering	Gallons Per Minute (gpm)
1 – 2	25,000
3 – 5	8,000 – 10,000
5 – 18	6,000 – 9,000

Source: Hydrologic Consultants, Inc. (HCI) 1999a.

The last segment of the proposed pipeline system would be an open canal system. The canal would begin near the western edge of Section 1, T35N, R49E, and continue approximately 5,700 feet to its terminus at Barrick's existing cooling canal located near the TS Ranch Reservoir (**Figure 2-7**). The canal would be constructed with 3.0 horizontal to 1.0 vertical (3.0H:1.0V) side slopes, a synthetic liner, a nominal 15-foot bottom width, and average 3.5 feet in depth (Power Engineers 1998). Approximately 23 acres of public land and 23 acres of private land controlled by Newmont (46 acres total) would be disturbed during construction of the pipeline and canal system.

Water would pocket in eight locations along the pipeline in low spots during dewatering shutdown periods. Occasionally, these pockets or low spots would be drained through valves to facilitate maintenance and repair of the pipeline. The volume of water to be drained ranges from 15,000 gallons to 500,000 gallons (210 feet to 6,900 feet of pipeline), depending on location. Water drained from the pipeline at each low spot would report to riprap areas located adjacent to the valve and infiltrated.

WASTE ROCK DISPOSAL FACILITY

Development of the Leeville Project would require construction of a new waste rock disposal facility to be located in Section 10, T35N, R50E (**Figure 2-4**). The waste rock disposal facility would be engineered for stability and designed, where practicable, with boundaries to blend with surrounding topography. The proposed waste rock disposal facility would disturb approximately 57 acres of public land with a capacity up to 4 million tons.

For the design of the waste rock disposal facility, a magnitude 7.0 earthquake was used for the maximum credible earthquake, based upon past regional seismicity and the apparent lack of continuous Holocene-age fault scarps within the site area (Newmont 1997a). However, since epicenters are not closely associated with identified faults in this region, the epicenter of an maximum credible earthquake could occur anywhere within the area (Ryall 1977).

Consistent with standard and accepted design practices, the value of 0.13 gravity (g) is taken as two-thirds of the maximum horizontal ground acceleration of 0.2g expected to occur as a result of the design seismic event of 7.0 on the Richter scale. Newmont has designed the waste rock storage facility with a horizontal coefficient of acceleration of 0.13g used to simulate earthquake loading for a pseudostatic case.

Waste rock would be placed by end-dumping down an advancing face in successive horizontal lifts of 20 to 120 feet, depending on topography. The waste rock disposal facility would be con-structed to an overall height of 120 feet above ground surface. Waste rock would be reclaimed at an overall average slope of 2.5H:1.0V.

A portion of waste rock resulting from development and operation of the Leeville Project underground mine would have Potentially Acid-Generating (PAG) waste rock. Due to the nature of underground mining, segregation of PAG waste rock is not usually possible. In cases where acid-base accounting (ABA) indicates the total mixture of waste rock is acid generating, Newmont would encapsulate PAG material within the waste rock disposal facility. Encapsulation is achieved by placing waste rock on a base constructed of compacted, low permeability materials, designed to prevent vertical migration of fluids. Base material would consist of mine waste rock and subsoil excavated from shaft sites that is random wheel compacted and sloped to allow drainage to a collection point. Majority of water draining to the collection point is lost to evaporation. Collection areas would be periodically inspected by Newmont personnel to determine conditions requiring removal and transport of excess water. Excess water would be trucked to Newmont's Mill 4 tailing facility located north of the Project site.

Figure 2-7

blank

The toe of sulfide (PAG) material is placed back from the perimeter limits of the ultimate footprint of the waste rock disposal site to allow placement of an outer cover of acid-neutralizing waste rock. Due to size sorting which occurs during end-dump construction, low permeability base would be overlain by the coarsest material within the next lift. This layer provides a preferred flow path for water migrating downward through the disposal facility, and promotes lateral flows along the low permeability base. This inhibits water from contacting the PAG waste rock for extended periods of time.

Surface drainage upslope of the base perimeter of the waste rock disposal facility would be diverted with ditches to prevent run-on to the disposal facility. During construction, a minimum 1 percent gradient would be maintained on lift surfaces to reduce infiltration. Surface compaction from haul trucks and dozer traffic would help minimize infiltration of water into the disposal facility.

A low permeability cap would be constructed on the final lift of PAG material. The cap would be constructed of random wheel compacted clay or alluvium to provide a barrier to limit infiltration fluid migration and thereby reduces the volume of acid rock drainage. The low permeability cap would be 24-inches thick and sloped to promote runoff, further reducing potential for water to contact PAG waste rock. The cap would be covered with 24-inches of growth medium and designed so regrading during final reclamation would not breach the cap.

Inspection of the waste rock disposal facility would be performed quarterly, and following heavy spring snow melt or precipitation, to detect abnormal conditions, anticipate remedial actions, and ensure integrity of ditches, berms, and collection ponds. Evaluation of waste rock analyses are included in permit-mandated Water Pollution Control Reports for the facility.

ORE STOCKPILES AND ORE PROCESSING

Approximately 14 million tons of refractory ore would be excavated through development of the Project. Ore would be directly hauled to Newmont's South Operations Area, or temporarily stockpiled in a refractory ore stockpile at the Project area (**Figure 2-4**) pending shipment to the South Operations Area. The ore would be shipped using 120 to 190-ton trucks. Haulage of refractory ore to the South Operations Area would be via the existing North-South Haul Road (**Figure 2-6**). Haul truck traffic associated with Leeville production on the North-South Haul Road would remain at existing levels of 25 to 40 trucks per day. Newmont anticipates haulage of refractory ore from existing sources in the North Operations Area would be decreasing at about the rate and time that the Leeville Project would be reaching production levels.

Construction of refractory ore stockpiles would be in accordance with Newmont’s Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a). Ditches would be constructed around the base of each stockpile to divert surface runoff away from the area. Refractory ore stockpiles would be built on low permeability bases compacted and sloped to allow drainage to a collection point. **Table 2-4** shows the facility capacities and dimensions of the stockpile.

The majority of water draining to the collection area is lost to evaporation. Collection areas would be periodically inspected by Newmont personnel to determine conditions requiring removal and transport of excess water. Excess water would be trucked to Newmont’s Mill #4 tailing facility located north of the Project site. Any refractory ore material remaining at the end of the Project would be removed to ore processing facilities at Mill #6. Refractory ore stockpiles are described in more detail in Newmont’s Plan of Operations (Newmont 1997a).

Tailing from processing Leeville ore at South Operations Area would be deposited in existing tailing disposal facilities. Modification or expansion of the tailing disposal facility beyond the current authorized capacity would not be required to process ore from the Leeville Project.

TABLE 2-4
Projected Facility Capacities and Dimensions

Facility	Capacity	Dimensions (Approximate)
Waste Rock Disposal	4,000,000 tons	1,700 ft L x 1,100 ft. W x 120 ft. H
Backfill Stockpile	1,000,000 tons	2,000 ft. L x 900 ft. W x 15 ft. H
Refractory Ore Stockpile	1,000,000 tons	2,000 ft. L x 1,400 ft. W x 10 ft. H
Topsoil Stockpile	500,000 cubic yards	1,400 ft L x 500 ft. W x 20 ft. H

Source: Newmont 1997a

ROADS

Haul Roads

Approximately 38 acres would be disturbed to construct haul roads (120-foot wide running width) to provide haul truck access to the Leeville Project production shaft, waste rock disposal facility, refractory ore stockpile, North-South Haul Road, backfill stockpile, and backfill plants. Construction of a road crossing would be completed at the intersection of the Leeville Project haul road and the Barrick Access Road. Signs would be installed to ensure traffic safety at this intersection.

Access Roads

Access roads would be constructed to provide service access to outlying ventilation shafts, water wells, pipelines, water treatment facility, and radio communication site. Existing exploration roads that currently provide access to these areas would be upgraded to an approximate running width of 25 feet and a maximum grade of 10 percent. Access roads would be graveled using acid-neutral to acid-neutralizing material from existing pits or gravel may be purchased from outside commercial sources. Culverts would be installed where access roads cross the Rodeo Creek channel. Preliminary designs indicate that 54-inch diameter culverts would be installed.

ANCILLARY FACILITIES

Ancillary facilities at the Leeville Project would be located above and below ground. Underground facilities would include electrical substations, powerlines, ore and waste rock storage bins, sumps and pump stations, and storage bins for cement and backfill.

Above ground facilities would include: equipment maintenance shop, explosives magazine, radio communication site, utility systems, septic drain field, fuel storage, water treatment facility, hydrocarbon bioremediation facility, landfill, warehouse, office, change house, security office, and surface water control ditch system.

A four-strand barbed wire fence with steel posts spaced every 10 feet would be installed along the east and northeast portions of the proposed facility boundary (**Figure 2-4**). Every seventh post would be a set post. Corners would have standard BLM-approved H-braces. Five-strand barbed wire gates would be used. Approximately 8,600 feet of new fence would be constructed and would tie into existing fences. Roads to the southeast ventilation shaft and radio communication site would likely be gated.

Backfill Plants

Newmont proposes to construct two backfill plants consisting of backfill stockpiles, conveyors, and cement silos. Measured amounts of dry cement and backfill material would be transferred through boreholes to a mixing plant located underground.

Energy

Electrical power would be provided by accessing an existing 120 kilovolt (kV) Sierra Pacific Power Company transmission line. Electrical power would be required at mine ventilation and pro-duction shafts, dewatering wells, and other surface support facilities; 25 kV would be required to service outlying dewatering wells. A new substation would be constructed for the Leeville Project to reduce voltage to 4.16 kV for distribution to underground and surface facilities.

Some of the shafts and facilities associated with the Leeville Project would be located along the current route of the transmission line. Newmont would coordinate with Sierra Pacific Power Com-pany to relocate the existing power line (N-47775 Power Line ROW) around Project facilities. Approximately 0.6 miles of the existing 120 kV power line would be relocated. A diesel-fired electrical generator would be installed for emergency evacuation and ventilation in the event of a power failure.

Water Control Ditches

Surface water control ditches would be con-structed as necessary around surface facilities, backfill stockpile, refractory ore stockpile, and waste rock disposal facility to control stormwater run-on to these sites. Surface water control ditches and sediment retention ponds would be designed and con-structed in accordance with Best Management Practices (BMPs) as outlined in the Handbook of Best Management Practices (Nevada State Conservation Commission 1994). Sediment ponds and diversion ditches would be sized to contain a 2-year, 6-hour precipitation event of 0.8 inches.

Newmont would obtain a stormwater discharge permit for the Leeville Project. Stormwater would be controlled using BMPs as defined by Nevada State Conservation Commission (1994) and include material handling procedures that minimize exposure of materials to stormwater; defines spill prevention and response measures; identifies sediment and erosion control measures; and describes physical stormwater controls. Stormwater run-on would be controlled by interceptor ditches upgradient of surface facilities. Interceptor ditches would be designed and constructed to accommodate a 2-year, 6-hour precipitation event (0.8 inches). Ditches would divert uncontaminated run-on water back into the natural drainage down gradient from disturbed areas.

Landfill

A Class III landfill would be located in the waste rock disposal facility for approved inert solid waste including wood, rock, brick, concrete, and vehicle tires. The specific disposal site on the waste rock disposal facility would change to coincide with area of active waste rock dumping. A hydrocarbon bioremediation facility would also be constructed to treat petroleum hydrocarbon contaminated soil on an inactive portion of the disposal facility. Hydrocarbon contaminated soil would result from petroleum spills or leaks occurring at the Leeville Project site.

GEOLOGIC EVALUATIONS

Newmont proposes to continue geologic evaluations (exploration) within the Leeville Project area during the life of the Project under this plan of operations. Geologic evaluation activities would include exploration and develop-ment drilling, geochemical sampling, excavation of test pits, trenching, and application of various geophysical methods. Surface disturbance created by drilling operations would consist of construction of roads, drill pads, and sumps. These activities would be conducted in accordance with approved exploration plans (N16-92-003P, and N16-93-002P) and applicable BLM and NDEP regulations and result in a maximum disturbance of 50 acres.

RESOURCE MONITORING

Air Quality

Newmont would obtain an air quality permit for the Leeville Project from NDEP. The permit would specify air quality monitoring requirements. Fugitive emissions would be controlled using BMPs as defined by the Nevada State Conservation Commission (1994). Dust emissions would be controlled through use of direct water application, chemical binders or wetting agents, dust collection devices and water sprays, and revegetation of disturbed areas concurrent with operations. Stationary sources of regulated air pollutants would be controlled to meet conditions of the NDEP air quality permit.

Water Resources

Water resources in the Leeville Project area are monitored within Boulder Flat and Maggie Creek hydrographic basins as part of Barrick's and Newmont's approved Plans of Operations. The current monitoring program addresses ground-water, springs/seeps, and streams/rivers. The purpose of hydrologic monitoring is to establish baseline data and report changing conditions as mining operations continue and expand in the area. Water quality, groundwater levels, and surface water flow are measured monthly, quarterly, or biannually at designated monitoring wells, springs/seeps, and surface water stations. Semi-annual monitoring reports prepared by Barrick (Boulder Valley Monitoring Plan) and quarterly reports prepared by Newmont (Maggie Creek Basin Monitoring Plan) summarize water resources monitoring data collected to date.

The U.S. Geological Survey (USGS) also collects groundwater and surface water data in the Project area. Additional details on the hydrologic monitoring program in the Project area are included in Chapter 3, *Water Quantity and Quality*. Newmont would monitor stability and function of the diversions and maintain them as required.

Newmont would monitor waste rock for potential acid generation in accordance with Water Pollution Control permits. Waste rock would be handled in accordance with Newmont's Refractory Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a).

Cultural Resources

Cultural resource inventories have been completed for the Leeville Project area. New sites that may be discovered during future cultural inventories would be mitigated by Newmont in accordance with Section 106 of the National Historic Preservation Act (Newmont 1997a). For additional discussion of cultural resources, see Chapters 3 and 4, *Cultural Resources*.

Paleontological Resources

In the event vertebrate fossils are discovered within the Leeville Project area during mining operations, Newmont would immediately notify the BLM Authorized Officer. Activities that could occur after notification include cessation of mining activities in the area of discovery, verification and preliminary inspection of discovery, and development/implementation of plans to avoid or recover the fossils.

HAZARDOUS MATERIALS

Quantities Greater Than Reportable Quantities

The term “hazardous materials” is defined in 49 CFR 172.101. Hazardous substances are defined in 40 CFR 302.4 and the Superfund Amendments and Reauthorization Act (SARA) Title III. Hazardous materials and hazardous substances that would be transported, stored, or used at the Leeville Project in quantities greater than the Threshold Planning Quantity (TPQ) designated by SARA Title III for emergency planning are summarized in **Table 2-5**.

The primary route for transporting hazardous materials to the Leeville Project area would be via State Highway 766 north of Carlin, Nevada and then via Barrick Road to the mine site. The alternative transportation route would be via Dunphy Road connecting to Barrick Road from the north. U.S. Department of Transportation (USDOT)-regulated transporters would be used for shipment. USDOT-approved containers would be used for on-site storage (Newmont 1997a), and spill containment structures would be provided. Hazardous materials would be stored in designated areas on private and public land, and in underground mine workings.

Ore mined at the Leeville Project would be processed at Newmont’s Mill #6 in the South Operations Area. Processing of Leeville ore would prolong the shipping and use of various chemicals used at Mill #6 by as much as ten years. Use of these chemicals is described and analyzed in the 1993 SOAP and 2001 SOAPA EISs.

Quantities Less Than Reportable Quantities

Small quantities of hazardous materials less than the TPQ not included in **Table 2-5** would also be managed at the Leeville Project area. These include auto and equipment maintenance products, office products, paint, and batteries.

Spill Prevention and Response Procedures

Newmont’s Spill Prevention, Control, and Countermeasure (SPCC) Plan (Newmont 1995a) states that all maintenance facilities and fueling vehicles would be equipped with spill response materials. Earth moving equipment would be available from the mining operation for constructing dikes. Above ground tanks and associated piping would be visually inspected for leaks on a daily basis. Bulk storage tanks would be constructed with secondary containment to accommodate 110 percent of volume of the largest tank. Mobile or portable storage tanks would be isolated to prevent hazardous materials spills from reaching surface water.

Newmont personnel would be instructed in operation and maintenance of equipment to prevent the discharge of oil. Spill response training would be provided through the Environmental Compliance Awareness Program outlined in Newmont’s Emergency Response Plan (Newmont 1995b). Supervisors would schedule and conduct spill prevention briefings for personnel that would include a review of the Spill Prevention, Control and Countermeasure Plan.

TABLE 2-5
Hazardous Materials Management
Leeville Project

Substance	Area Used/Stored	Rate of Use (per year)	Quantity Stored On-site	Storage Method	Waste Management
Diesel Fuel	Mine/truck shop	1,500,000 gal	20,000 gal	Bulk tank	No waste
Hydraulic Fluid	Mine/truck shop	80,000 gal	3,000 gal	Bulk tank totes, drums	Recycled
Motor Oil	Mine/truck shop	20,000 gal	1,500 gal	Bulk tank totes, drums	Recycled
Antifreeze	Mine/truck shop	1,500 gal	480 gal	Bulk tank totes, drums	Recycled
Explosives	Mine/(surface & underground)	1,300,000 lbs	25,000 lbs	Magazines (surface & underground)	No waste
Gasoline	Mine/truck shop	15,000 gal	5,000 gal	Bulk tank	No waste
Propane	Mine/surface	1,500,000 gal	45,000 gal	Bulk tank	No waste
Grease	Mine/truck shop	15,000 lbs	2,400 lbs	Totes, drums	Recycled

gal = gallon; lbs. = pounds
Source: Newmont 1997a

Known spills, malfunctioning components, and precautionary measures would be discussed during briefings.

Hazardous Wastes

Hazardous waste generation, treatment, and disposal is regulated by the federal Resource Conservation and Recovery Act (RCRA)(40 CFR §260-270.) Under RCRA, Newmont would be considered a "conditional exempt small quantity generator," for activities at the Leeville Project because less than 100 kilograms of hazardous waste would be generated each month.

Newmont has a waste minimization program to evaluate hazardous substances used on mine property. Where possible, alternative products that generate no waste or solid waste, rather than RCRA-regulated hazardous waste, would be used. Hazardous wastes generated at the Leeville Project would be transported to permitted waste disposal facilities by licensed waste haulers. When practicable, the wastes would be sent to recycling facilities.

Toxic Release Inventory

Since 1998, the mining industry has been required to comply with Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA, Public 99-499, Title III, Superfund Amendment and Reauthorization Act, 1986) and Section 6607 of the Pollution Prevention Act. These laws are intended to increase public awareness and access to information concerning the presence and release of toxic chemicals present in the community. The Act is often referred to as the Toxic Release Inventory (TRI) and requires certain type facilities to meet specific criteria including those facilities with specified Standard Industrial Classification code designations and provide annual reports to state and federal agencies regarding releases of listed toxic and hazardous chemicals to the environment.

The proposed Leeville Project falls within Standard Industrial Code 1041, and Newmont is subsequently required to submit Chemical release Reporting Forms (Form R or A) for listed chemicals that exceed designated thresholds to Environmental Protection Agency (EPA) and State of Nevada.

Forms R or A are required for all Section 313 chemicals and compounds which exceed annual threshold levels for "manufacturing" (25,000 pounds), "processing" (25,000 pounds), and "otherwise used" (10,000 pounds) classifications. In reporting year 2001, companies must report to a 10 pound threshold level for Persistent Bioaccumulative Toxins, which includes lead and mercury.

Airborne emissions of elements and compounds associated with processing Leeville Project ore would be emitted as a portion of the total emissions from Newmont's South Operations Area. A discussion of elements and compounds released to the environment is included in *Chapter 4 – Air Quality.*

HUMAN HEALTH AND SAFETY

Human health and safety at the Leeville Project would be regulated by the federal Mine Safety and Health Act of 1977 (MSHA), which sets

TABLE 2-6
Leeville Project Health and Safety Training Programs

Course	Personnel	Frequency	Duration	Instruction
New-hire Training	All new hires exposed to mine hazards	Once	24 hours	Employee rights Supervisor responsibilities Self-rescue Respiratory devices Transportation controls Communication systems Escape and emergency evacuation Ground control hazards Occupational health hazards Electrical hazards First aid Explosives Toxic materials
Task Training	Employees assigned to new work tasks	Before new assignments	Variable	Task-specific health and safety procedures Supervised practice in assigned work tasks in nonproductive duty
Refresher Training	All employees who received new-hire training	Yearly	8 hours	Required health and safety standards Transportation controls Communication systems Escapeways, emergency evacuations Fire warning Ground control hazards First aid Electrical hazards Accident prevention Explosives Respirator devices
Hazard Training	All employees exposed to mine hazards	Once	Variable	Hazard recognition and avoidance Emergency evacuation procedures Health standards Safety rules Respiratory devices

Source: Newmont 1997a.

mandatory safety and health standards for surface metal and nonmetal mines. The purpose of these health and safety standards is the protection of life, promotion of health and safety, and prevention of accidents. MSHA regulations are codified under 30 CFR Subchapter N, Part 56. Employees at the Leeville Project area would be required by Newmont to receive training as outlined in **Table 2-6.**

EMPLOYMENT

The Leeville Project would employ approximately 400 people. Most of the work force for the Leeville Project would be from existing mine-related work forces in the Carlin Trend. The construction work force for the Leeville Project would be approximately 300 people during the initial year of construction and decrease to approximately 50 employees during the final year of construction. Construction and development are expected to require approximately 48 months to complete.

RECLAMATION

Reclamation activities for the Leeville Project are designed to achieve post-mining land uses consistent with BLM's Resource Management Plan for the Elko District. Reclamation is intended to return disturbed land to a level of productivity comparable to pre-mining levels associated with adjacent land. Post-mining land uses include wildlife habitat, livestock grazing, dispersed recreation, and mineral exploration and development.

Short-term reclamation goals would be to stabilize disturbed areas and protect disturbed and adjacent undisturbed areas from unnecessary or undue degradation. Long-term reclamation goals would be to ensure public safety, stabilize the site, and establish a productive vegetative community consistent with post-mining land uses.

Reclamation activities would include shaft closure and regrading the waste rock disposal facility, removal of structures after cessation of operations, regrading disturbed areas (including roads), drainage control, well closure (e.g. dewatering wells, piezometers, etc.), removal and regrading stockpile areas, replacement of salvaged soil, revegetation, and reclamation monitoring. The reclamation schedule would encompass the period between cessation of mining through revegetation. Reclamation activities are expected to be initiated in 2020 and completed approximately 8 years after mining ceases. Reclamation would take place concurrent with operations where possible. The proposed post-reclamation topography for the Leeville Project is shown on **Figure 2-8**, and cross sections through selected portions of the reclaimed area are presented on **Figure 2-9**. A Closure Plan meeting State of Nevada requirements (NRS 519A.010 to 519A.280 and NAC 519A.010 to 519A.415) must be filed with NDEP two years prior to closure of the mine.

Soil Salvage

As the mine shaft areas, haul and access roads, stockpile sites, and waste rock disposal areas are developed; Newmont would recover available topsoil for future use in reclaiming disturbed areas. Topsoil recovery depths would be determined during salvage operations by reclamation specialists. Topsoil would be salvaged and transported to stockpiles using scrapers, wheel dozers, track dozers, haul trucks, and loaders. One topsoil stockpile would be constructed immediately south of the Refractory Ore Stockpile. Topsoil salvage depths are summarized in Chapter 3, *Soils*.

Grading Disturbed Areas

Prior to replacing soil or a suitable growth medium, facility sites would be graded to the slope configurations shown on **Figure 2-9**. Grading is designed to create a stable post-mining configuration for disturbed areas, establish effective drainage to minimize erosion, and protect surface water resources. To the extent practicable, grading would blend disturbed areas with the surrounding terrain. Angular features, including tops and edges of waste rock disposal facilities, would be rounded.

Rock faces associated with construction of mine facilities would remain after cessation of operations and reclamation. Acceptable fill material would not be available for reclamation of these rock faces and topography of the areas associated with the rock faces does not allow for stable placement of material to backfill these rock exposures.

Prior to initiating the proposed reclamation vegetation plan, Newmont would evaluate topsoil replacement depths for north and south exposures. Soil replacement depths would vary according to location and soil type. The variety of replacement depths would provide different vegetation mosaics on reclaimed areas.

The regraded surface would be ripped where necessary prior to placement of topsoil. Ripping would reduce compaction, provide a uniform seed bed, and establish a bond between the seed and topsoil.

Revegetation

Newmont's revegetation program goals are to stabilize reclaimed areas, ensure public safety, and establish a productive vegetative community based on the applicable land use plan and designated post-mining land uses (Newmont 1997a). **Table 2-7** is the proposed seed list for reclamation in the Leeville Project area. Actual seed mixes to be used during reclamation would be selected from the plant list in **Table 2-7** depending on availability or cost, and would be applied at a rate of approximately 15 pounds pure live seed (PLS) per acre. Modifications in the seed list, application rates, cultivation methods, and techniques could occur based on success of concurrent reclamation. Changes and/or adjustments to seed mixtures and application rates would be developed through consultation with and approval by BLM and NDEP. Seedlings may be substituted for seeds.

The seed mix selected would represent a Reclaimed Desired Plant Community and the mix would be appropriate for each ecological site description in the study area.

TABLE 2-7
Plant List for Leeville Project Area

Grasses	
Bluebunch wheatgrass	***Agropyron spicatum***
Thickspike wheatgrass	***Agropyron dasystachyum***
Streambank wheatgrass	***Agropyron riparium***
Western wheatgrass	***Agropyron smithii***
Sandberg bluegrass	***Poa sandbergii***
Great Basin wildrye	***Elymus cinereus***
Indian ricegrass	***Oryzopsis hymenoides***
Webber ricegrass	***Oryzopsis webberi***
Idaho fescue	***Festuca idahoensis***
Green needlegrass	***Stipa viridula***
Bottlebrush squirreltail	***Sytantion hystrix***
Crested wheatgrass	***Agropyron cristatum***
Sheep fescue	***Festuca ovina***
Slender wheatgrass	***Agropyron trachycaulum***
Canby bluegrass	***Poa canbyi***
Sand dropseed	***Sporabolus cryptandrus***
Alkali sacaton	***Sporabolus airoides***
Forbs	
Yellow sweetclover	***Melilotus officinalis***
Cicer milkvetch	***Astragalus cicer***
Northern sweetvetch	***Hedysarum boreale***
Buckwheat	***Eriogonum***
Common sainfoin	***Onobrychis viciaefolia***
White sweetclover	***Melilotus alba***
Alfalfa	***Medicago sativa***
Annual ryegrass	***Lolium perenne multiflorum***
Barley	***Hordeum***
Western Yarrow	***Achillea millefolium***
Blue flax	***Linum lewisii***
Gooseberry leaf globemallow	***Sphaeralcea grossulariaefolia***
Small burnet	***Sanguisorba minor***
Scarlet globemallow	***Sphaeralcea coccinea***
Desert globemallow	***Sphaeralcea ambigua***
Arrowleaf balsamroot	***Balsamhoriza saggitata***
Palmer penstemon	***Penstemon palmeri***
Shrubs	
Wyoming big sagebrush	***Artemisia tridentata var. tridentata, wyomingensis***
Antelope bitterbrush	***Purshia tridentata***
Serviceberry	***Amelanchier (alnifolia) utahensis***
Snowbrush	***Ceanothus spp.***
Winterfat	***Ceratoides lanata***
Chokecherry	***Prunus virginiana***
Black sagebrush	***Artemisia nova***
Shadscale	***Atriplex confertifolia***
Fourwing saltbush	***Atriplex canescens***
Prostrate kochia	***Kochia prostrata***
Rubber rabbitbrush	***Chrysothamnus nauseosus***
Mormon tea	***Ephedra (nevadaensis) (viridis)***
Currant	***Ribes spp.***
Woods rose	***Rosa woodsii***
Snowberry	***Symphoricarpos spp.***

Source: Newmont 1997a.

Figure 2-8

blank

Figure 2-9

blank

Concurrent Reclamation

Newmont has been conducting concurrent reclamation at the Leeville Project area addressing disturbances resulting from exploration activities. These disturbances include drill roads, trenches, sumps, and drill pads. As various facilities reach the end of their period of use, Newmont would initiate reclamation activities concurrent with ongoing mining operations.

Underground Mine Shafts

The system of five shafts would be reclaimed at ground surface in a manner to preserve them for potential future use while safe-guarding humans and wildlife. Potential future uses may include extraction of deposits that are sub-economic at the time of reclamation but may become economic in the future, or exploration and development of undiscovered deposits in the area.

The shafts would be sealed using steel, pre-stressed beams encapsulated in a 4-foot thick concrete slab constructed at the top of the shaft. The slab would be constructed on steel beams that span the collar of the shaft to prevent collapse and would overlap the shaft collar by approximately 2-feet on each edge. The concrete shaft lining would prevent animals from burrowing into shaft walls. The shaft lining thickness would vary up to 48 inches where poor ground conditions occur. **Figure 2-10** is a typical cross section showing design of the shaft capping system. **Figure 2-11** is a plan view of the shaft closure design to be used at the Leeville Project. As shown on **Figure 2-10**, the shaft collar would be backfilled with approximately 16-feet of uncompacted waste rock placed on top of the concrete cap. A mound of compacted clay would be placed over the backfill resulting in an approximate 8-foot high mound as measured from ground surface. Topsoil would be placed on top of the compacted clay to provide a growth medium for revegetation.

Earthen berms would be constructed around the remaining rock faces and signs posted to warn of potential hazards associated with the rock faces. Abandoned boreholes would be plugged in a manner similar to exploration drill holes in compliance with NAC 534. The lower portion would be filled with pelletized bentonite or bentonite slurry and the upper portion with concrete.

Waste Rock Disposal Facility

The waste rock disposal facility associated with the Leeville Project would be regraded to a final reclaimed slope angle of 2.5H:1.0V as shown on **Figure 2-9**. Remaining benches combined with the bench face angles would result in an overall slope angle of 2.5H:1.0V for the 120-foot height of the facility. Grading would be done to minimize rill erosion, facilitate reclamation activities (seeding, mulching), and provide a surface that would support vegetation. The top of the waste rock disposal facility and the remaining benches would be graded to promote runoff and limit ponding of precipitation and snowmelt (**Figure 2-9**).

Upon completion of grading, topsoil or other suitable growth medium would be redistributed to an average depth of 24 inches over the waste rock. The waste rock would be regraded, ripped (to relieve compaction from mining equipment), and seeded according to the reclamation plan (Newmont 1997a).

PAG waste rock produced during mining operations would be placed on a low permeability base. If acid-base accounting tests indicate the total mixture of waste rock produced from the Leeville Project is acid-generating, the waste rock facility would be encapsulated. Encapsulation of the waste rock facility would be as described in the Waste Rock Disposal Facilities section of this Chapter, and in accordance with the Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a).

Ore and Backfill Stockpiles

Refractory ore stockpiles and backfill stockpiles would be removed at the end of mine life and the stockpile areas reclaimed. **Figure 2-8** shows the reclaimed topography associated with the stockpile sites.

Roads

Roads associated with the Leeville Project would be reclaimed concurrently with cessation of operations in each individual area. Roads remaining at the end of mining operations would be reclaimed when no longer needed for reclamation and access.

Haul roads associated with waste rock disposal areas would be reclaimed concurrently with closure of the disposal site. Haul roads not located on the waste rock disposal site would be reclaimed by regrading to provide proper drainage, topsoil replacement, and revegetation. The reclaimed roads would be regraded, to the extent practical, to reestablish the original topography and drainage of the site and to control erosion. Culverts would be removed and natural drainage reestablished.

Exploration roads, drill pads, sumps, and trenches would be reclaimed in conjunction with ongoing operations. Exploration roads and drill pads are bladed or formed using a dozer. The disturbed soil material forms the roadbed or drill pad. Upon reclamation the disturbed soil material is recontoured or regraded onto the disturbed area to blend with surrounding topography. Trenches are excavated with a dozer or backhoe. Trenches are backfilled and regraded to conform to the surrounding topography and drainages are reestablished.

Ancillary Facilities

At the end of the Leeville Project mine life, the explosives magazine, ancillary buildings, water supply pipeline, and other mine support structures with significant salvage value would be dismantled for salvage or used for other operations in the area. Concrete foundations would be broken up to the extent possible and buried a minimum of 5-feet below ground surface. Access drifts and excavations for underground facilities would not be backfilled.

Unused explosives would be returned to the vendor or used at other mine sites in adjacent areas. Non-salvageable material including scrap building materials and equipment would be buried onsite in the landfill or disposed of offsite in accordance with federal and state regulations. Hazardous material would be decontaminated and disposed of at approved landfills.

The water pipeline would be reclaimed by plugging the pipe at both ends and allowing the pipe to remain buried. The canal would be backfilled, regraded, and revegetated to match the surrounding ground surface.

Monitoring/Evaluation of Reclamation Success

Newmont in cooperation with BLM and NDEP, would evaluate the status of vegetative growth during three full growing seasons following completion of regrading, resoiling, and planting. Final bond release may be considered at that time. Interim progress of reclamation at the Leeville Project area would be monitored as requested by the agencies. Water monitoring, as described in the Resource Monitoring section of this chapter, would also be used in evaluating reclamation success.

PROJECT ALTERNATIVES

This section describes alternatives to the Proposed Action (Leeville Project), including the No Action Alternative and Alternatives Considered but Eliminated from Detailed Analysis. Alternatives selected by BLM for consideration in this EIS are based on potential impacts or issues associated with the Proposed Action, including those identified by the public during the scoping process. BLM is required to analyze environ-mental effects resulting from the Proposed Action and to identify reasonable alternatives that would mitigate, minimize or eliminate potential impacts. BLM is also required to analyze the No Action Alternative and describe the environmental consequences that would result if the Proposed Action is not implemented.

Figure 2-10

blank

Figure 2-11

blank

Major components of the proposed mine development, their respective functions, and potential environmental effects resulting from implementation of these activities are con-sidered in development of alternatives. Potential mitigation measures are described in Chapter 4 for each resource. Other alternatives were considered early in the review process. These alternatives were eliminated because they were either technically or economically infeasible, or they provided no environmental advantage over the Proposed Action.

ALTERNATIVES CONSIDERED IN DETAIL

Four alternatives are described in this section of the EIS: **Alternative A –** Eliminate Canal Portion of Water Discharge Pipeline System; **Alternative B** – Backfill Shafts; **Alternative C –** Relocate Waste Rock Disposal Facility and Refractory Ore Stockpile; and **No Action Alternative**.

Alternative A – Eliminate Canal Portion of Water Discharge Pipeline System

Issue: A canal, 5,700 feet in length, would be constructed as the last segment of the proposed pipeline system. The canal would begin near the western edge of Section 1, T35N, R49E, and continue approximately 5,700 feet to its terminus at Barrick's existing cooling canal located near the TS Ranch Reservoir (**Figure 2-7**). An open canal may have potentially significant impacts on wildlife.

Alternative A would incorporate all components of the Proposed Action but would eliminate the canal. Alternative A would require Newmont to extend the pipeline to the confluence with Barrick's cooling canal.

Alternative B – Backfill Shafts

Issue: Newmont proposes to cover the pro-duction and ventilation shafts associated with the Leeville Project with a reinforced concrete cover once the shafts are no longer needed to support activities in the Project area. Because concrete shaft covers would not have an indefinite life span, complete backfill of the shafts is evaluated as an option that would provide an effective, long-term closure of the shafts.

Alternative B would include implementation of all components described in the Proposed Action and would require Newmont to backfill the production and ventilation shafts associated with the Leeville Project. Based on maximum design specifications for the five shafts included in the Proposed Action, approximately 166,000 cubic yards of material would be needed to backfill the shafts. Newmont would use waste rock generated from the mining operation as backfill for the shafts. Waste rock would be recovered from the waste rock disposal facility. Removal of 166,000 cubic yards of waste rock for use as backfill would require approximately 1,500 trips using 170-ton haul trucks and would not result in a reduction in surface disturbance for the waste rock disposal facility.

Backfilling the shafts would eliminate the need for reinforced concrete closures Newmont has proposed for the shafts. The uppermost portion of the shaft would be backfilled with overburden and then topsoiled to support vegetation.

Backfill and closure of shafts would occur at such time that Newmont decides that no further access or activity is required in the Leeville Mine area. Newmont would maintain a closure bond for backfilling the shafts in an amount estab-lished by the agencies to ensure closure under this alternative. This bond would be periodically reviewed and adjusted to reflect current costs of backfilling. Upon satisfactory closure by Newmont, the bond would be released by BLM and NDEP.

Alternative C – Relocate Waste Rock Disposal Facility and Refractory Ore Stockpile

Issue: Under the Proposed Action, construction and operation of Newmont's proposed waste rock disposal facility and refractory ore stockpile would disturb approximately 118 acres of land in Section 10, T35N, R50E. Placement of these facilities on currently disturbed land in Section 3, T35N, R50E would result in reducing the disturbance associated with the Leeville Project by 118 acres. Disturbance acres associated with these facilities would be relocated onto currently disturbed private land owned by Newmont. **Figure 2-12** is a layout of Alternative

C. Total new disturbance associated with the Leeville Mine Project would be 368 acres (335 public, 33 private) under Alternative C.

Alternative C would incorporate all components of the Proposed Action but would require Newmont to locate the waste rock disposal facility and refractory ore stockpile in Section 3, T3N, R50E. Placement of these mine facilities would not result in new disturbance in Section 3.

Existing mining operations located in Section 3 are associated with Newmont's North Area Leach (NAL) facilities. The area in Section 3 that would be used for the proposed Leeville Mine waste rock disposal facility and refractory ore stockpile have been previously used as a Refractory Ore Stockpile facility for Newmont's North Area Operations. The existing stockpile site is built in accordance with Newmont's Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a).

Runoff from waste rock and refractory ore placed on the NAL Refractory Ore Stockpile site would infiltrate onto an underlying compacted clay liner system and drain to an existing collection system associated with the NAL Refractory Ore Stockpile facility. The existing NAL water control ditch system would be used to contain surface water run-on/run-off.

Reclamation of the Leeville Mine waste rock disposal facility and refractory ore stockpile would be consistent with the approved reclamation plan for the NAL Refractory Ore Stockpile facility. This reclamation plan includes regrading the surface of the facility, placement of growth media, and seeding.

No Action Alternative

Under the No Action Alternative, the Proposed Action would not be approved. Newmont would not be authorized to develop defined ore reserves, construct ancillary mine facilities, place waste rock in the disposal facility, or construct the dewatering system discharge pipeline on public land. Potential impacts predicted to result from development of the Project would not be realized.

FEATURES COMMON TO PROPOSED ACTION AND ALTERNATIVES

The following components of Newmont's proposed Plan of Operations for the Leeville Project are common to the Proposed Action and Alternatives:

- Mining the Leeville Project ore deposits;
- Constructing and operating a waste rock disposal facility;
- Placing refractory ore in temporary stockpiles;
- Transporting ore from the Leeville Project site and/or refractory ore stockpile via the North-South Haul Road to Newmont's South Operations Area for processing;
- Rerouting an existing Sierra Pacific Power Company power line;
- Constructing ancillary facilities, including office complex, perimeter fence, production and ventilation shafts, equipment maintenance facility, explosives magazine, soil stockpiles, septic field, water distribution facilities, dewatering system discharge pipeline, and fueling station;
- Continuing geologic evaluations; and
- Reclamation activities, including closure and regrading of the waste rock disposal facility, removal of structures after cessation of operations, regrading of disturbed areas (including roads), drainage control, well closure, removal and regrading of stockpile areas, replacement of salvaged soil, revegetation, and reclamation monitoring.

Agency Preferred Alternative

The agency preferred alternative is Alternative A – Eliminate Canal Portion of Water Discharge Pipeline System; Alternative B – Backfill Shafts: and, Alternative C – Relocation of the Waste Rock Disposal Facility and Refractory Ore Stockpile.

Figure 2-12

blank

MITIGATION AND MONITORING MEASURES

This section contains descriptions of mitigation and monitoring measures included in Newmont's proposed Plan of Operations for the Leeville Project. Mitigation and monitoring measures described below apply to the Proposed Action and Alternatives:

- All surface disturbance would be reclaimed in accordance with applicable federal, state, and local regulations;
- Topsoil would be salvaged from proposed disturbance areas. Soil material would be stockpiled for future use or directly hauled to regraded areas and placed in preparation of final surface reclamation;
- Most mined-out stopes would be backfilled with development waste rock or cemented rock fill consisting of aggregate and cement mixtures;
- Surface water control ditches would be constructed as necessary around surface facilities, stockpiles, and waste rock disposal facility to control surface water run-on/run-off;
- Encapsulation of potentially acid-generating waste rock would be completed in accordance with the Refractory Ore Stockpile and Waste Rock Dump Design, Construction, and Monitoring Plan (Newmont 1997a);
- Shaft walls would be grouted to prevent inflow of groundwater. During construction of the shafts and for the life of the mine any localized inflow of groundwater into the shaft would be pumped to the surface, treated for hydrocarbon removal and used for dust suppression and mine development.
- Surface water and groundwater monitoring would continue until federal and state agencies determine it is no longer necessary. The monitoring program would be evaluated and revised annually based on water quality and quantity data, and updated numerical model results;
- Vegetative growth would be evaluated during three growing seasons following completion of regrading, resoiling, and seeding; and
- Revegetated areas would remain fenced to protect from livestock grazing. Seedlings may be used to establish shrub vegetation.

ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED ANALYSIS

This section describes alternatives to the Proposed Action that were eliminated from further review in the EIS. These alternatives were identified during the public scoping process or by BLM during review and analysis of the Proposed Action. These alternatives were considered technically infeasible, unreasonable, provided no advantage over the Proposed Action, or would not meet the purpose and need of the Proposed Action.

Alternative Discharge Outfall for Leeville Dewatering System

This alternative would incorporate all components of the Proposed Action, and would require Newmont to construct a pipeline to connect the Leeville Project dewatering system to Newmont's water treatment and cooling complex located at Maggie Creek near Newmont's Gold Quarry Mine.

A pipeline terminating at Newmont's Gold Quarry water treatment and cooling complex would be more than 7 miles longer than the proposed pipeline. The alternative pipeline would disturb 104 acres compared to 46 acres under the Proposed Action. The longer pipeline would cross State Highway 766 and possibly Maggie Creek twice in the "lower narrows" section. The pipeline for the Proposed Action would not cross any major roadways or perennial drainages. This alternative would have no advantage compared to the Proposed Action or Alternative A.

Grouting Underground Mine Workings to Reduce Dewatering Discharge

This alternative would include all components of the Proposed Action, and would require Newmont to implement a grouting program to reduce the rate of groundwater inflow to underground mine workings. This would be accomplished by drilling numerous, closely spaced boreholes to depths below the base of the underground workings. Grouting compound would be injected into boreholes to seal water-transmitting fractures and joints. The net effect of grouting underground workings would be that less water would need to be pumped from the aquifer to reduce groundwater inflow to underground mining operations. Since less water may need to be removed, the potential exists that Newmont could eliminate the need for a pipeline to discharge excess groundwater, or could reduce the size of the pipeline necessary to convey discharge water off-site. The overall capacity of the mine dewatering system and the quantity of water needing treatment could also be reduced under this alternative.

BLM has determined that a site-wide grouting program is not a reasonable alternative for the proposed Leeville Project. State-of-practice drilling and grouting technologies are such that accurate placement of grout at the desired locations would not be possible. In addition, the grout curtain could be jeopardized by stresses induced by normal mining practices and seismic activity. This would result in an unacceptable degree of risk to human safety (Herbert 1998).

CHAPTER 3

AFFECTED ENVIRONMENT FOR PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

Existing resources in the Leeville Project area are described in this chapter. The Project area is located in the Boulder Creek drainage in northern Eureka County, northeastern Nevada (**Figure 3-1**). Elevations range from 5,000 feet above mean sea level (AMSL) in the south and west valley bottom areas to over 7,000 feet AMSL in the Tuscorora Range along the east side of the Project area.

Figure 3-1 shows the general study area for geology and minerals, paleontology, soil, vegetation, invasive nonnative species, and cultural resources. The study area boundaries for air quality; water quantity and quality; wetlands/riparian zones; fisheries and aquatic resources; terrestrial wildlife; threatened, endangered, candidate and sensitive species; grazing management; recreation and wilderness; noise; extend beyond the boundaries depicted on **Figure 3-1** and are described in the respective resource discussions in this chapter. Study areas for each environmental resource are based on the predicted locations of direct and indirect impacts from the Proposed Action.

Appendix 5 of BLM NEPA Handbook (H-1790-1) identifies Critical Elements of the Human Environment. The appendix is a list of elements of the human environment that are subject to requirements specified in statutes or executive orders and must be considered in all BLM environmental assessments (EAs) and environmental impact statements (EISs). The following Critical Elements of the human environment and other resources are potentially affected by the Proposed Action and Alternatives:

- Air Quality
- Cultural Resources
- Environmental Justice
- Invasive, Nonnative Species
- Migratory Birds
- Native American Religious Concerns
- Paleontology
- Threatened, Endangered, Candidate, and Sensitive Species
- Wastes (hazardous or solid)
- Water Quality (Surface/Ground)
- Wetlands/Riparian Zones
- Wilderness

The following Critical Elements of the Human Environment have been analyzed by BLM and would not be affected by the Proposed Action or alternatives or are not present in the proposed Project area:

- Areas of Critical Environmental Concern
- Floodplains
- Wild and Scenic Rivers
- Farmland (prime or unique)

This chapter provides a summary of environmental baseline information. In the following sections, “Project area” and “study area” refer to the Proposed Action and land surrounding the proposed mine, respectively. The “area of potential effect” as used in the *Cultural Resources* section is synonymous with the Project area.

GEOLOGY AND MINERALS

A description of regional geology and gold mineralization in northern Nevada is presented in Chapter 2, *History of Exploration and Mining*. This section of Chapter 3 provides a detailed description of geology in the Leeville Project area.

The Leeville Project area is located within the Basin and Range Physiographic Province, a region that extends over most of Nevada and parts of adjoining states. Range-front faulting in the province has created north-south trending fault-block mountain ranges separated by broad valleys filled with alluvium. The geologic history of the study area is summarized in **Table 3-1**.

The Leeville Project area extends from the crest of the Tuscarora Mountains westward across a portion of the Little Boulder Basin to the east edge of the Tuscarora Spur. Valley fill in the Little Boulder Basin consists of poorly-indurated Tertiary-age volcanoclastic sand, tuff, and gravel of the Carlin Formation overlain by Quaternary-age alluvium (**Figures 3-2** and **3-3**). Depth to Paleozoic bedrock in the basin ranges from 0 to 350 feet.

Bedrock in the Tuscarora Mountains is comprised primarily of early Paleozoic-age (505 to 360 million years before present) limestone, silty limestone, dolomite, silty mudstone, chert, and quartzite. Paleozoic-age rocks include the Ordovician-age Vinini Formation (western siliceous assemblage), which was thrust over the Devonian-age Rodeo Creek, Popovich, and the Silurian to Devonian-age Roberts Mountains Formation (eastern carbonate assemblage) along the Roberts Mountains Thrust (**Figures 3-2** and **3-3)**. The upper plate Vinini Formation is comprised of 900 to 1,200 feet of chert, mudstone, greenstone, and silty limestone that was deposited in a deep marine environment. Lower plate rocks are composed of: siliceous mudstone and siltstone of the Rodeo Creek unit (300 feet thick); thin to medium bedded limestone and silty limestone of the Popovich Formation (150 to 250 feet thick); and thin to medium bedded limestone and silty limestone of the Roberts Mountains Formation (1100 to 1550 feet thick) (Jackson et al. 1997). Paleozoic rocks of Ordovician age underly the Roberts Mountains Formation and include dolomite of the Hanson Creek Formation, the Eureka Quartzite, and dolomite and limestone of the Pogonip Group (**Figure 3-2**). The eastern assemblage carbonate rocks of the lower plate were deposited on the western edge of the continental shelf of the North American craton (McFarlane 1991b).

During the middle Paleozoic (360 to 300 million years before present), an island arc collided with the edge of the continent causing an upwarp known as the Antler Orogeny. This collision resulted in the Roberts Mountains Thrust. Erosion of the highland resulted in deposition of sediments to the east and west during late Paleozoic time (300 to 245 million years before present). During the Mesozoic Era (65 to 225 million years before present), granitic stocks and dikes intruded the area along pre-existing high angle faults. During the Cenozoic Era (66 million years ago to present), active tectonics including volcanism, crustal extension, and high-angle faulting affected the area and shaped the existing topography. Faulting and folding are widespread, particularly in the flanks of the Tuscarora Mountains and Tuscarora Spur. Regional folding and localized drag folding are present with one of the more prominent folds, the Tuscarora Anticline, forming the Tuscarora Spur. Paleozoic-age rocks and faults are offset by Tertiary-age high-angle faults (**Figure 3-3**).

Ore in the Leeville Project area occurs in two strata-bound zones located in the upper 350 feet of the Roberts Mountains Formation. Ore grade mineralization is located in the footwall of the West Bounding Fault, which trends northeast, dips 60 degrees west, and has approximately 150 feet of apparent normal displacement. The thickest and highest-grade portion of the deposit is located where the northwest-striking Rodeo Creek Fault intersects the footwall of the West Bounding Fault. Ore occurs in grey to black, decalcified (calcite removed) and weakly to moderately silicified rocks composed of 60 to 70 percent quartz, 10 to 30 percent dolomite, 7 to 16 percent kaolinite and illite, and 2 to 4 percent pyrite (Jackson et al. 1997). Mineralized zones of the ore body occur at depths of 1,500 to 2,000 feet below ground surface.

Figure 3-1

blank

Figure 3-2

blank

Figure 3-3

blank

TABLE 3-1
Geologic History of the Leeville Project Area

	Geologic Time[1]	Geologic Occurrence	Relationship to Mineralization
Cenozoic Era (0-65)	Quaternary Period (0-3)	Recent localized erosion, deposition, and circulation of groundwater.	Mineralized host rocks are unaffected by local erosion and deposition of surface rocks. Groundwater circulation does not oxidize mineral deposit.
		Regional extension, high-angle faulting, shallow intrusion, and volcanism followed by fluvial and lacustrine deposition (Tertiary-age sediments of the Carlin Formation).	Mineralizing fluids associated with the igneous activity deposit gold and associated sulfides in two strata bound areas in the Roberts Mountains Formation. Carlin Formation sediments are deposited after gold mineralization.
	Tertiary Period (3-65)	High-angle faulting along NW and NE trends. Local emplacement of igneous dikes along high-angle fault zones.	Structural movements prepare rock for mineralization. Hydrothermal solutions migrate along high-angle structures and sedimentary bedding planes depositing minerals.
Mesozoic Era (65-225)	Mesozoic Era (65-225)	Regional emplacement of granitic and dioritic intrusive rocks. Dikes are intruded along previously existing high angle faults which offset rocks of both the upper and lower Roberts Mountains Thrust plates.	Lamprophyre and quartz monzonite dikes are intruded. These dikes may be the source of base metal mineralization in the Carlin Trend and also may have caused silicification of the Popovich Formation, which appears to have controlled later gold bearing mineralization.
Paleozoic Era (225-590)	Late Devonian and Early Mississippian Period (325-360)	Antler Orogeny occurs pushing deeper water marine sedimentary rocks (western assemblage chert and mudstone of the Vinini Formation) eastward along the Roberts Mountains thrust over shallower water marine sedimentary rocks (eastern assemblage silty limestones and calcareous siltstones of the Roberts Mountains Formation, Popovich, and Rodeo Creek units).	Structural compression and thrust faulting in the deposit area.
	Devonian Period (345-395) Silurian Period (395-430) Ordovician Period (430-500)	Deposition of marine sedimentary rocks. Roberts Mountains Formation sediments (thin to medium bedded limestone and silty limestone) grade upwards into Devonian-age Popovich unit fossiliferous limestone. Upper Devonian-age siliceous mudstones and calcareous siltstones of the Rodeo Creek unit overlie Popovich unit limestones. Deposition in the deeper westward ocean of chert, mudstone, greenstone, and limestone of the Vinini Formation.	Upper portion of the Roberts Mountains Formation is later the host to the Leeville Project ore deposits.

Note: [1]Geologic time presented with names of geologic time periods and millions of years before present in parentheses.

Source: Jackson et al. 1997; Radtke 1985; and McFarlane 1991b.

AREA SEISMICITY

The Leeville Project area is located in the Great Basin seismic zone, a region characterized by moderately high rates of seismic activity (Algermissen et al. 1982). To identify historic earthquakes in the project vicinity, two radial searches extending approximately 30 miles and 90 miles from the site (latitude 40 degrees 56 minutes and longitude 116 degrees 20 minutes) were conducted using the U.S. Geological Survey (USGS) and University of Nevada - Reno Seismology Laboratory databases for the time period of 1872 to 1997. Historic earthquakes (post-1872) within 30 miles of the site have ranged from barely detectable to magnitude 5.1. Two magnitude 5.1 earthquakes have occurred: one on September 18, 1945, 24 miles south-southwest of the site, and the other on October 22, 1966, 22 miles south from the site. Within a 90-mile radius of the Project, only one earthquake event was recorded greater than magnitude 5.9. This event occurred in Pleasant Valley on October 15, 1915 with a magnitude of 7.8 (dePolo and dePolo 1999). The epicenter of this earthquake was located approximately 68 miles southwest of the Project site in Pleasant Valley, Nevada. As recently as August 25, 2001, an earthquake with a magnitude of 3.4 occurred about 43 miles northwest of Elko, Nevada (41.19 N Lat., 116.43 W. Long.). The epicenter was located 20 miles west of Tuscarora, Nevada and 50 miles northwest of the Project site.

The closest evidence of historic (post-1872) surface faulting is approximately 68 miles from the Project site at the location of the October 15, 1915, Pleasant Valley earthquake (Chen-Northern 1988). The nearest surface-rupture faults with prehistoric Holocene-age displacement (active faulting between 12,000 years ago and 1870), as mapped by Slemmons (1983), are located in Boulder Valley, approximately 8 miles west-south-west of the Project. Boulder Valley faults were estimated to have had displacement within the last 2,000 years (Slemmons 1983). No active faults (faults with Holocene-age surface offset) have been detected within the Leeville Project area.

During project design, potential effect of earthquake shaking on project facilities was assessed. Parameters typically used to characterize seismicity are: 1) magnitude of the controlling earthquake; 2) maximum horizontal acceleration induced in bedrock at the site by the controlling earthquake; and 3) probability of occurrence of the controlling earthquake.

The maximum predicted earthquake magnitude (M) for the area, as determined by several researchers, is shown in **Table 3-2**. Researchers used two separate methods to assess seismicity in the region: 1) estimation of the maximum credible earthquake based on determination of active faults in the area, and, 2) probabilistic estimation of the risk of earthquake occurrence based on regional seismic modeling. The maximum credible earthquake is the largest earthquake that can be reasonably expected to occur on a fault or over an area. Using the probabilistic approach, Algermissen et al. (1982) estimated that the probability of not exceeding bedrock acceleration of 0.17 gravity (g) in any given 50-year period would be 90 percent, and the probability of not exceeding 0.35g in 250 years would also be 90 percent (**Table 3-2**).

GEOLOGIC RESOURCES

Gold mining has been the primary activity within the vicinity of the Leeville Project area since 1907, when placer gold deposits were discovered along Lynn, Sheep, and Rodeo creeks (BLM 1992). More recently, disseminated gold deposits have become the focus of mining and exploration projects. Prior to initiation of the exploration projects in 1973, mining-related disturbance within the Leeville Project was limited to shallow surface exploration activities consisting of "glory holes" or excavation of placer deposits. These exploration activities tend to be concentrated in the eastern portion of the Project area, on the west slope of the Tuscarora Mountains.

TABLE 3-2
Seismic Characterization for the Leeville Project Area

Assessment Method	Maximum Earthquake Magnitude (M)	Maximum Horizontal Acceleration (g)	Probability of Occurrence
Regional probabilistic assessment	7.3	0.17	90% probability of not being exceeded in 50 years
	7.3	0.35	90% probability of not being exceeded in 250 years

Note: gravity (g) = 9.81 meters per $second^2$

Source: Algermissen et al. 1982; 1990.

Since 1992, Newmont has been exploring for deep mineralization north of the Carlin Mine. Newmont's efforts from exploration projects at the High Desert and Chevas sites have resulted in discovery of the Leeville deposits. The proposed operations area of the Leeville Project encompasses portions of these exploration projects. Delineated mineralization consists of the West Leeville, Four Corners, and Turf ore deposits present at depths of 1,000 to 2,500 feet below the existing ground surface. The Leeville Project would produce approximately 3,984,000 tons of waste rock and 14,081,000 tons of ore during development of these deposits.

MINE ROCK CHARACTERIZATION

Three deeply buried gold bearing deposits occur in the Leeville Project area: 1) West Leeville; 2) Four Corners; and 3) Turf. Two distinct tectonic units, the upper plate and the lower plate, are present in the area of the deposit. These two units are separated by a thrust fault. All three ore deposits are located within the lower plate.

The upper plate is comprised of a single geologic formation known as the Vinini Formation (Ovi), consisting of siliceous mudstones, siltstones, cherts, silty limestones and their metamorphosed equivalents. The lower plate is comprised of three geologic formations: Rodeo Creek Formation (Drc), consisting of siliceous mudstones, siltstones and sandstones; and the Popovich (Dp) and Roberts Mountains (SDrm) formations, consisting of silty limestones. Three types of mine rock have been identified for the three deposits: 1) unoxidized carbonate rock, 2) carbon sulfide refractory rock, and 3) unoxidized intrusive rock. Ten geochemical rock classifications (**Table 3-3**), which have variable acid-generation and metal release potential, are defined based on grade, lithology, mineralogy, and thrust plate location.

A suite of 966 representative samples were collected from drill cuttings and evaluated for acid-generation potential using the Net Carbonate Value (NCV) static test method. Of the 966 samples submitted, 44 percent were Turf waste rock, 30 percent West Leeville waste rock, 14 percent Four Corners waste rock, 7 percent West Leeville ore, and the remaining 5 percent Four Corners ore.

Results of NCV tests indicate that of 966 samples analyzed, 61 percent are in the range of neutral to highly basic, with the greatest population (24 percent) occurring in the highly basic category. The remaining 39 percent of samples are in the range of slightly acidic to highly acidic, although only a small portion fall in the highly acidic category (3 percent). NCV data suggest that West Leeville and Turf deposits are gen-erally basic, and Four Corners deposits are gen-erally acidic or potentially acid-generating (PAG).

This information was used to develop composites that represent bulk composition for each of the ten identified geochemical rock types. The number and length of composited intervals varied between materials, as summarized by Coxon (1997). In addition, two master composite samples were prepared to represent run-of-mine ore and waste material from the West Leeville, Four Corners, and Turf deposits over the duration of the Project (Coxon 1997). The master ore and waste composite samples were analyzed for whole rock geochemistry by SVL Analytical, Inc. of Kellogg, Idaho. Results of these analyses (summarized in **Table 3-4**) indicate compositions of ore and waste rock are very similar, and that the rocks are composed primarily of silicates followed by carbon (loss on ignition or LOI), aluminum, magnesium, calcium, iron, and trace amounts of titanium, potassium, manganese, phosphorus, and barium.

The acid-generating potential of waste rock associated with the Proposed Action was reported in a memorandum by Coxon (1997). This study included static geochemical testing of individual drill hole assay samples. The waste lithology composites were also analyzed for acid- generation potential. The number of samples included in each composite is summarized in **Table 3-5** with the Net Neutralization Potential (NNP), which is equal to Acid Neutralization Potential (ANP), less the Acid Generation Potential (AGP) and the Neutralization Potential Ratio (NPR), which is equal to ANP/AGP.

The NPR values confirm that Four Corners waste rock is PAG (i.e., NPR less than the BLM standard 3:1 and the NDEP standard 1.2:1). The majority of the waste is non-PAG. Meteoric Water Mobility Procedure (MWMP) tests were conducted on 15 composite samples including 10 waste rock lithology composites, 3 ore rock lithology composites, and 2 master waste rock and ore rock composites.

TABLE 3-3
Mine Rock Classification
Leeville Mine Project

Rock Type	Deposit	Domain	Formation	Lithology
WLW1	West Leeville	Upper Plate	Ovi	Unoxidized Carbonate
WLW2	West Leeville	Upper Plate	Ovi	Carbon Sulfide Refractory
WLW3	West Leeville	Lower Plate	SDrm, Dp	Unoxidized Carbonate
FCW1	Four Corners	Lower Plate	Drc, Dp, SDrm	Carbon Sulfide Refractory, Unoxidized Carbonate, Unoxidized Intrusive
TW1	Turf	Upper Plate	Ovi	Unoxidized Carbonate
TW2	Turf	Upper Plate	Ovi	Carbon Sulfide Refractory
TW3	Turf	Lower Plate	Dp	Unoxidized Carbonate
TW4	Turf	Lower Plate	SDrm HW	Unknown
TW5	Turf	Lower Plate	SDrm FW	Unknown
TW6	Turf	Lower Plate	SDrm	Unoxidized Carbonate

WLW = West Leeville Waste; FCW = Four Corners Waste; TW = Turf Waste; Ovi = Vinini Formation; SDrm = Roberts Mountains Formation; Dp = Popovich Formation; Drc = Rodeo Creek Formation; HW = Hanging Wall; FW = Foot Wall.
Source: Coxon 1997.

TABLE 3-4
Whole Rock Analytical Results
Leeville Mine Project

Master Composite	Major Elements (percent by weight)											
	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	MnO	P_2O_5	BaO	LOI[1]
Ore	65.57	0.275	5.693	2.402	3.279	5.296	<0.27	0.705	0.014	0.133	0.044	8.50
Waste	65.96	0.256	5.404	1.853	2.847	5.894	<0.27	0.622	0.015	0.167	0.134	9.00

SiO_2 = silica; TiO_2 = titanium oxide; Al_2O_3 = aluminum oxide; Fe_2O_3 = iron oxide; MgO = magnesium oxide; CaO = calcium oxide; Na_2O = sodium oxide; K_2O = potassium oxide; MnO = manganese oxide: P_2O_5 = phosphate; BaO = barium oxide; LOI: Loss on ignition, surrogate for carbon.
Source: Coxon 1997.

TABLE 3-5
Waste Rock Tonnage (ABA Data from Laboratory Analyses)
Leeville Mine Project

Waste Rock					ABA Values	
Deposit and Lab No.	n	Domain	Formation	Lithology	NNP	NPR
WLW1 - West Leeville 99624	139	UP	Ovi	UC	10.2	1.3
WLW2 - West Leeville 99623	113	UP	Ovi	CSR	106	4.1
WLW3 - West Leeville 104992	59	LP	Unk	UC	152	15.7
FCW1 - Four Corners 112948	167	LP	Unk	CSR	-27.1	0.4
TW1 - Turf 143586	105	UP	Drc	CSR	9.5	1.4
TW2 - Turf 143587	205	UP	Dp	UC	104	3.2
TW3 - Turf 153007	62	LP	SDrm HW	UC	171	6.5
TW5 - Turf 153009	126	LP	SDrm FW	Unk	137	6.3
TW6 - Turf 153010	213	LP	SDrm	UC	315	26.2
Total	**1189**					

Note: NA = Data not available; ABA = acid-base accounting; NNP = net neutralization potential; NPR = neutralization potential ratio; WLW = West Leeville Waste; FCW = Four Corners Waste; TW = Turf Waste; LP = Lower Plate; Ovi = Vinini Formation; Drc = Rodeo Creek Formation (Turf Deposit); Dp = Popovich Formation; SDrm = Roberts Mountains Formation; HW = Hanging Wall; FW = Foot Wall; UC = unoxidized carbonate; CSR = carbon sulfide refractory; Unk-Unknown; n = number of samples included in composite. ABA run for waste rock only. Source: Coxon 1997.

All three deposits tested (i.e., West Leeville, Four Corners, and Turf) exhibit a tendency for leaching most metals tested as shown in **Table 3-6,** in some cases above pertinent standards. The only metals that show no elevated concentrations with respect to standards are barium, lead, mercury, and silver. For beryllium, chromium, selenium and copper, only one ore sample exceeded the respective water quality standards. For non-metal parameters tested, most samples exceeded standards for sulfate and total dissolved solids (TDS). With the exception of a Four Corners ore sample, the pH values are in the range of 6.8 to 8.4 standard units.

TABLE 3-6
Meteoric Water Mobility Procedure Leach Extraction Results for Leeville Mine Project Drill Hole Composite Samples

Sample Type							Metals (mg/L)								
No.	n	Dep	Dom	Fm	Lt	Gd	Sb	As	Ba	Be	Cd	Cr	Cu	Fe	Pb
99624	139	WLW1	UP	Ovi	UC	W	0.043	0.125	0.031	<0.001	<0.002	<0.003	<0.003	<0.017	0.002
99623	113	WLW2	UP	Ovi	CSR	W	0.048	0.082	0.035	<0.001	<0.002	<0.003	0.011	<0.017	<0.001
104992	59	WLW3	LP	Unk	UC	W	1.45	0.067	0.024	<0.001	<0.0024	<0.005	0.004	<0.024	0.002
112946	65	WLO	LP	SDrm	UC	O	1.11	0.118	0.016	<0.001	<0.0024	<0.005	<0.003	<0.024	<0.005
112948	167	FCW	Unk	Unk	Unk	W	1.75	0.843	0.021	<0.001	<0.0024	<0.005	0.006	0.2	<0.005
112947	48	FCO	Unk	Unk	Unk	O	0.656	30.2	0.024	0.017	<0.012	1.85	9.74	668	<0.005
143586	105	TW1	UP	Ovi	UC	W	0.025	0.57	0.155	<0.001	<0.0024	<0.005	0.018	1.52	0.004
143587	205	TW2	UP	Ovi	CSR	W	0.033	0.75	0.215	<0.001	<0.0024	<0.005	0.024	1.21	0.004
153007	62	TW3	LP	Dp	UC	W	0.106	<0.04	0.014	<0.002	0.017	<0.008	<0.004	0.03	<0.004
153008	72	TW4	LP	SDrm HW	Unk	W	0.364	0.41	0.043	<0.002	<0.002	<0.008	<0.004	<0.019	<0.004
153009	126	TW5	LP	SDrm FW	Unk	W	0.143	0.17	0.019	<0.002	0.004	0.016	<0.004	<0.019	<0.004
153010	213	TW6	LP	SDrm	Unk	W	0.302	0.63	0.024	<0.002	<0.002	<0.008	<0.004	<0.019	<0.004
153006	173	TO	Unk	Unk	Unk	O	0.109	<0.04	0.017	<0.02	0.019	<0.008	<0.004	9.39	<0.004
182633	Nd	Master Composite Waste					0.149	<0.04	0.029	<0.002	<0.002	NA	<0.004	0.054	<0.002
182532	Nd	Master Composite Ore					0.096	<0.04	0.034	<0.002	0.035	NA	<0.004	189	0.008
Nevada Water Quality Standards							**0.146**	**0.05**	**2.0**	**0.004***	**0.005**	**0.1**	**1.3***	**0.3*(s)**	**0.05**

	Metals (mg/L)							Non-Metals						
No.	Mn	Hg	Ni	Se	Ag	Tl	Zn	Cl	Fl	NO_3	CN	SO_4	TDS	pH
99623	0.021	<0.0002	<0.021	0.02	<0.002	<0.001	<0.002	3.03	0.68	0.11	<0.01	503	829	8.07
99624	0.031	<0.0002	<0.021	0.031	<0.002	<0.001	0.006	4.19	1.18	0.25	<0.01	555	910	8.22
104992	0.025	<0.0002	0.04	0.021	0.003	0.008	0.007	4.13	0.29	<0.05	<0.01	728	1270	7.84
112946	0.077	0.0003	<0.017	0.008	<0.003	0.033	0.003	7.04	<0.2	<0.1	.0.01	1500	2550	7.91
112948	1.11	0.0005	1.79	0.018	<0.003	0.01	0.119	4.92	1.95	<0.25	<0.01	863	1390	7.68
112947	1.51	<0.0002	7.81	<0.01	0.053	0.798	9.17	8.29	5.54	0.67	<0.01	3660	5570	2.98
143586	0.024	0.0003	0.034	<0.04	0.009	<0.001	0.035	11.2	0.7	<0.02	<0.01	206	684	8.37
143587	0.099	0.0002	0.07	0.05	0.009	<0.01	0.067	6.9	2.0	0.38	<0.01	217	558	8.17
153007	1.53	<0.0002	5.52	<0.048	<0.005	0.028	6.07	21.4	0.7	0.1	<0.01	1980	3230	7.39
153008	0.086	<0.0002	0.135	<0.048	<0.005	0.01	0.024	20.2	1.1	0.18	<0.01	796	1400	7.79
153009	0.398	<0.0002	0.681	<0.048	<0.005	0.014	0.688	17.9	1.1	0.25	<0.01	1470	2380	7.59
153010	0.009	<0.0002	0.021	<0.048	<0.005	0.005	<0.004	22.1	1.2	0.16	<0.01	633	1040	7.79
153006	3.64	0.0003	4.95	<0.048	<0.005	0.061	6.31	14.2	0.8	0.12	<0.01	2730	4500	6.86
182633	0.91	<00002	0.852	0.064	<0.005	0.032	0.472	7.4	0.7	0.1	<0.01	2030	3070	7.56
182532	3.44	0.0007	4.16	<0.048	0.008	0.236	8.85	7.6	1.6	0.15	<0.01	3480	5640	5.75
	0.05*(s)	**0.002**	**0.0134**	**0.05**	**--**	**0.013**	**5.0*(s)**	**250**	**4.0**	**10**	**0.2**	**250**	**500**	**5.0-9.0**

Nevada water quality standards are the "Municipal or Domestic Supply" values listed in **Table 3-13**; if no corresponding standard exists, the federal drinking water standard is used and denoted by an asterisk (*). Values with (s) are secondary drinking water standard.

Shading indicates results exceed Nevada water quality standards.

mg/L = milligrams per liter; n = number samples included in each composite; Nd = No data; Dep = Deposit; WLW = West Leeville Waste; FCW = Four Corners Waste; FCO – Four Corners Ore; TW = Turf Waste; TO = Turf Ore; Dom = Domain; UP = Upper Plate; LP = Lower Plate; Unk = Unknown; Fm = Formation; Ovi = Vinini Fm; SDrm = Roberts Mountains Fm ; Dp = Popovich Fm; HW = Head Wall; FW = Foot Wall; Lt = Lithology; CSR = Carbon Sulfide Refractory; UC = Unoxidized Carbonate; Gd = Grade; W = Waste Rock; O = Ore; Sb = antimony; As = arsenic; Ba = barium; Be = beryllium; Cd = cadmium; Cr = chromium; Cu = copper; Fe = iron; Pb = lead; Mn = manganese; Hg = mercury; Ni = nickel; Se = selenium; Ag = silver; Tl = thallium; Zn = zinc; Cl = chloride; Fl = fluoride; NO_3 = nitrate; CN = cyanide; SO_4 = Sulfate; TDS = Total Dissolved Solids; pH = standard units.

Source: Coxon 1997.

PALEONTOLOGICAL RESOURCES

Fossils in northeastern Nevada include vertebrate animals, invertebrate animals, and plants. Fossils in the study area have a relatively broad regional distribution, and are not restricted to any one area. Most invertebrate fossils found in the region of the Leeville Project are of Paleozoic-age. Mammalian fossils found on BLM land during a survey of the Gold Quarry Mine to the south include remains of Cenozoic-age horses, camels, and rodents (Firby and Schorn 1983).

The majority of invertebrate fossils in the Project area occur in Ordovician, Silurian, and Devonian-age rocks and include:

- Brachiopods and conodonts in the Vinini Formation (Rubens et al. 1967; Stewart and McKee 1977);
- Corals, bryozoa, brachiopods, and crinoid fragments in limestone of the Popovich unit (Baker 1991); and
- Coral, bryozoa, brachiopods, mollusks, trilobites, tenticulitids, graptolites, conodonts, and crinoid fragments in the Roberts Mountains Formation (Firby 1993; Coates 1987).

Although uncommon, invertebrates of Tertiary-age have been found in the Humboldt and Carlin Formations, which are synonymous to some authors (Eaton 1994). Mollusks and leaf floras have been collected from the Carlin Formation (BLM 1992), whereas ostracods occur in the Humboldt Formation (Firby 1992).

Vertebrate fossils are generally found in Tertiary-age sediments, although the Roberts Mountains Formation has some potential for Paleozoic vertebrate fossils. Mammalian fossils of Tertiary-age discovered in Elko and Eureka counties include prehistoric horses, camels, rhinos, and rodents (Firby and Schorn 1983; Regnier 1960). These fossils have been found in the Carlin and Raine Ranch Formations. Devonian-age fish fossils have been recovered in the Roberts Mountains Formation about 70 miles south of the Leeville Project area (Firby 1992).

AIR QUALITY

METEOROLOGY

The Leeville Project area is subject to large daily temperature fluctuations, low relative humidity, and limited cloud cover. Wind data collected at Newmont's North Area Leach Facility, located approximately 1 mile from the Leeville Project, indicate the most common wind direction is from the southeast but is influenced by daily heating and cooling of hills and drainage areas **(Figure 3-4)**. Local topographic features frequently cause wind to flow in the direction of the valley (also known as drainage wind). Average wind speed is 8.4 miles per hour.

The Tuscarora Mountains rise to approximately 7,000 feet AMSL directly east of the Project area and markedly influence wind, precipitation, and temperature. After sunset, cool mountain air flow is down slope across the Project area. Temperatures increase after sunrise, as warm valley air rises up slope until midday, when ground heating causes instability and variable wind directions.

TEMPERATURE AND PRECIPITATION

The Project area is located approximately 20 miles northwest of Carlin, Nevada. General meteorological conditions in the area are represented by data collected by the National Weather Service at Elko, Beowawe, and Tuscarora. Temperature data are also available from the Carlin Mine, located approximately 1 mile south of the Project area. Average monthly temperature and precipitation data from these sites provide a description of general weather patterns in the region (**Table 3-7**).

Mean monthly temperatures recorded at the Beowawe, Elko, and Tuscarora meteorological stations vary from 67-71^{o} F in July and August to 24-28^{o} F in December and January. The 1966-2000 Carlin Mine temperature data are consistent with those recorded from the three National Weather Service stations. Monthly mean minimum and maximum daily temperature values from the mine site demonstrate that the range of temperatures within a month typically vary by 20^{o} F or more.

Figure 3-4

blank

Table 3-7 shows mean monthly precipitation and temperature data for the Beowawe, Elko, and Tuscarora meteorological stations. These stations show similar trends, with heaviest precipitation falling from November through January as snow, and in May and June as rain. Summer precipitation occurs mostly as scattered showers and thunderstorms that contribute relatively little to overall precipitation.

AIR QUALITY

The State of Nevada and federal government have established ambient air quality standards for criteria air pollutants. The criteria pollutants are carbon monoxide (CO), lead (Pb), sulfur dioxide (SO_2), particulate matter smaller than 10 microns (PM_{10}), ozone, and nitrogen dioxide (NO_2).

Ambient air quality standards must not be exceeded in areas where the general public has access. **Table 3-8** lists the Nevada and federal primary and secondary air quality standards.

National primary standards are the levels of air quality necessary, with an adequate margin of safety, to protect the public health. National secondary standards are the levels of air quality necessary to protect the public welfare from known or anticipated adverse effects of a regulated air pollutant.

These standards, other than for ozone and those based on annual averages, must not be exceeded more than once per year. The ozone standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above the standard is equal to or less than one.

The attainment status for pollutants within the Project area is determined by monitoring levels of criteria pollutants for which National Ambient Air Quality Standards (NAAQS) and Nevada Ambient Air Quality Standards exist. Air quality in Eureka and Elko counties is classified as attainment or unclassified for all pollutants. Attainment or unclassified designation means no violations of Nevada or national air quality standards have been documented in the region.

TABLE 3-7
Leeville Project Area Temperature and Precipitation

Meteorological Station	Elevation (feet)	Period of Record		Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Ann.
Average Maximum, Average Minimum, and Mean Temperature (degrees F)																
Beowawe	4,684	1949-2000	Max	40	48	53	63	72	82	92	90	81	67	51	41	65
			Min	15	21	25	30	37	44	50	47	39	29	22	15	31
			Mean	27	33	39	46	55	63	71	68	59	48	36	28	48
Newmont's Carlin Mine	6,530	1966-2000	Max	35	39	44	52	62	72	83	83	72	59	43	35	57
			Min	20	23	26	31	40	49	58	58	48	38	27	20	36
			Mean	27	31	35	41	51	61	71	71	60	48	35	27	46
Elko	5,050	1888-2000	Max	37	43	51	60	69	80	91	89	79	66	50	39	63
			Min	11	17	24	29	36	42	48	45	36	28	20	13	29
			Mean	24	30	37	45	52	61	69	67	58	47	35	26	46
Tuscarora	6,170	1957-2000	Max	37	40	45	53	63	73	84	83	73	62	45	38	58
			Min	16	19	23	28	35	42	50	48	40	32	24	18	31
			Mean	27	30	34	41	49	58	67	66	56	47	34	28	45
Mean Monthly Precipitation (inches)																
Beowawe	4,684	1949-2000	Mean	0.82	0.65	0.76	0.80	1.20	0.91	0.27	0.43	0.50	0.60	0.80	0.80	8.54
Carlin Mine	6,530	1966-2000	Mean	1.18	0.97	1.26	1.11	1.30	1.13	0.40	0.46	0.98	0.96	1.13	1.58	12.46
Elko	5,050	1888-2000	Mean	1.20	0.95	0.92	0.80	0.99	0.80	0.36	0.40	0.45	0.71	0.91	1.07	9.55
Tuscarora	6,170	1957-2000	Mean	1.27	0.99	1.11	0.87	1.46	1.21	0.53	0.47	0.79	0.93	1.42	1.47	12.52

Source: Western Regional Climate Center 2001.

In 1997, the United States Environmental Protection Agency (EPA) revised the federal primary and secondary particulate matter standards by establishing annual and 24-hour standards for particles 2.5 micrometers in diameter or smaller ($PM_{2.5}$). States will be required to submit attainment designations for each $PM_{2.5}$ area within one year after receipt of three years of air quality data, expected to be available in the 2002-2003 time frame. Significant technical difficulties still exist with respect to $PM_{2.5}$ monitoring, emission estimation, and modeling. Until these difficulties are resolved, PM_{10} may be used as a surrogate for $PM_{2.5}$ in meeting new source review permitting requirements.

Air Quality Monitoring Data

PM_{10} ambient air quality data have been collected within the towns of Elko and Battle Mountain since 1993. Ambient ozone data were collected at the Saval Ranch along State Route 225 north of Elko from 1989 through 1993. In addition, PM_{10} was measured at the Betze/Post Mine air monitoring station from 1990 through 1992. **Table 3-9** lists available air quality monitoring data for the Leeville Project area and surrounding sites. Ozone monitoring is no longer conducted in north-central Nevada. Ozone monitoring in Nevada is limited to Clark and Washoe Counties.

The PM_{10} data from the Elko and Battle Mountain monitoring stations represent air quality within populated areas. The primary contributors to ambient particulate concentrations in populated areas is road dust and residential wood smoke. Air quality data from the Betze/Post Mine monitoring station are representative of air quality surrounding active mine sites in the area. Air quality violations have not been identified at any of the stations.

TABLE 3-8
State of Nevada and National Ambient Air Quality Standards

Pollutant	Averaging Time	Concentration	Comments
Ozone	1 hour	235 $\mu g/m^3$ (0.12 ppm)	National Primary Standard and Nevada Standard
Carbon Monoxide, below 5,000 ft AMSL	8 hours	10,000 $\mu g/m^3$ (9.0 ppm)	National Primary Standard and Nevada Standard
Carbon Monoxide, at or above 5,000 ft AMSL	8 hours	6,670 $\mu g/m^3$ (6.0 ppm)	Nevada Standard only; National 8-hour Standard is same for all elevations
Carbon Monoxide, all elevations	1 hour	40,000 $\mu g/m^3$ (35 ppm)	National Primary Standard and Nevada Standard
Nitrogen Dioxide	Annual Arithmetic Mean	100 $\mu g/m^3$ (0.053 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	Annual Arithmetic Mean	80 $\mu g/m^3$ (0.03 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	24 hours	365 $\mu g/m^3$ (0.14 ppm)	National Primary Standard and Nevada Standard
Sulfur Dioxide	3 hours	1,300 $\mu g/m^3$ (0.5 ppm)	National Secondary Standard and Nevada Standard
Particulate Matter as PM_{10}	Annual Arithmetic Mean	50 $\mu g/m^3$	National Primary Standard and Nevada Standard
Particulate Matter as PM_{10}	24 hours	150 $\mu g/m^3$	National Primary Standard and Nevada Standard
Lead (Pb)	Quarterly Average	1.5 $\mu g/m^3$	National Primary Standard and Nevada Standard
Visibility	Observation	In sufficient amount to reduce the prevailing visibility to less than 30 miles when humidity is less than 70%	Nevada Standard only
Hydrogen Sulfide	1 hour	112 $\mu g/m^3$ (0.08 ppm)	Nevada Standard only

Note: $\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million; AMSL = above mean sea level.

Source : NDEP 1997

TABLE 3-9
PM_{10} and Ozone Monitoring Data

Site	Year	Annual Mean ($\mu g/m^3$)	24-Hour High ($\mu g/m^3$)	24-Hour 2nd High ($\mu g/m^3$)
PM_{10} Monitoring Data				
Betze/Post Mine	1990	18	44	30
	1991	17	74	45
	1992	11	20	20
City of Elko	1993	28.8	79	66
	1994	31.3	87	59
	1995	35.4	75	74
	1996	32.3	119	107
	1997	24.8	49	46
	1998	19.0	91	58
	1999[1]	18.5	48	46
City of Battle Mountain #1	1992	30.5	83	46
	1993	-	-	-
	1994	33.5	95	66
	1995	34.4	95	65
	1996	41.3	244	91
	1997	31.8	83	64
	1998	26.5	149	61
City of Battle Mountain #2	1998	16.4	69	59
	1999[1]	16.0	54	39
Ozone Monitoring Data				
Site	**Year**	**Annual Mean (ppm)**	**1-Hour High (ppm)**	**1-Hour 2nd High (ppm)**
Saval Ranch	1989	0.0532	0.080	0.076
	1990	0.0513	0.078	0.077
	1991	0.0533	0.091	0.088
	1992	0.0513	0.079	0.074
	1993	0.0565	0.084	0.078

Note: PM_{10} = particulate matter smaller than 10 microns; $\mu g/m^3$ = micrograms per cubic meter; ppm = parts per million;
[1] 1999 data collection is not for complete year

Source: EPA 1999.

PSD CLASSIFICATION

The area surrounding the proposed Leeville Project is a designated Class II area as defined by the Federal Prevention of Significant Deterioration of Air Quality (PSD) program. The PSD Class II designation allows moderate growth or degradation of air quality within certain limits above baseline air quality. Industrial sources proposing construction or modifications must demonstrate that proposed emissions would not cause significant deterioration of air quality in all areas. Standards for significant deterioration are stricter for Class I areas than Class II areas. The nearest Class I area is the 64,667 acre Jarbidge Wilderness, located approximately 75 miles northeast of the proposed Leeville Project.

The Jarbidge Wilderness contains rugged, glaciated mountainous terrain. The Jarbidge Mountains form a single crest and maintain elevations between 9,800 and 11,000 feet for approximately 7 miles. Eight peaks exceed 10,000 feet elevation. Scenic views within the Jarbidge Wilderness range from sagebrush flatland to high, rugged, rocky peaks. As a federal mandatory Class I area, the Jarbidge Wilderness receives visibility protection through the PSD air quality permitting process. There are no designated Integral Vistas associated with the Jarbidge Wilderness.

Two other wilderness areas are located in the Humboldt National Forest southeast of the Project area: East Humboldt Wilderness and Ruby Mountain Wilderness. Neither of these wilderness areas are mandatory federal Class I airsheds. The BLM manages 10 Wilderness Study Areas (WSA) in the Elko District, seven of which (all or portions of) have been recommended for wilderness designation. None of these WSAs are mandatory Class 1 airsheds (Hawthorne 2001).

ONGOING OPERATIONS

Existing mining and ore-processing operations in the Leeville Project area produce criteria pollutant emissions, most notably from articulate matter. Particulate matter is emitted from point sources such as crushers and boilers. Fugitive particulate matter emissions are created by drilling, blasting, hauling and crushing rock, and from road dust. Combustion products including carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and hydrocarbons are emitted from boilers, kilns, stationary engines and vehicle engines. Sulfur dioxide, hydrogen sulfide, sulfuric acid mist and particulate sulfur are emitted during ore processing in autoclaves. **Table 3-10** contains a list of existing permitted point source air pollutants in the Boulder Flat air quality management basin.

TABLE 3-10
Existing Permitted Point Sources of Air Pollutants
Boulder Flat Air Quality Management Basin

Dee Gold Mine – Boulder Creek	Jaw crusher, screen, cone crusher Conveyor, ore bin Cargon regeneration kiln Induction furnace Lime storage bin Cyanide storage bin Cement storage bin
Newmont Mill #4	Gyratory crusher, hopper, feeder Cement silo Reclaim tunnel apron feeder Lime bin Secondary cone crusher
Barrick and Newmont Betze/ Post Mine	Mill crusher, reclaim hopper Mill lime silo Heap leach crushing system Carbon reactivation kiln Cement silo Melting furnace (electric) Autoclaves (6) Steam boiler Lime silo ADR furnace (electric) ADR carbon reactivation kiln
Newmont North Area Heap Leach	Gyratory crusher Cone crushers (2) Screens (2) Cement bin
Newmont Carlin and Deep Star Mines	Aggregate hoppers and conveyors Cement silos Metal removal screens and conveyors

Source: McVehil-Monnet Associates, Inc. 1993; 1994.

WATER QUANTITY AND QUALITY

The study area for water resources includes portions of the following hydrographic areas: Boulder Flat (No. 61), Rock Creek Valley (No. 62), Willow Creek Valley (No. 63), Maggie Creek Area (No. 51), Marys Creek Area (No. 52), Susie Creek Area (No. 50), and the adjoining portion of the Humboldt River (**Figure 3-5**).

SURFACE WATER QUANTITY

The Leeville Project area is located on the west slope of the Tuscarora Mountains within the Boulder Flat hydrographic area. Boulder Creek, the primary surface water drainage in this hydrographic area, generally drains southwest toward Rock Creek and the Humboldt River, located approximately 20 miles from the Project site (**Figure 3-5**). Boulder, Bell, Brush, and Rodeo creeks are minor, intermittent drainages and do not support sufficient flows to maintain a defined channel to the Humboldt River. There are no natural ponds or lakes in the vicinity of the Leeville Project. A description of stock ponds in the Project area is in the *Grazing Management* section of this chapter.

The Leeville Project is located on the drainage divide in the headwater of Rodeo Creek and Sheep Creek, both of which are intermittent drainages in the Boulder Creek basin (**Figure 3-1 and Figure 3-5**). The eastern portion of the proposed pipeline route is located in the Sheep Creek drainage, and the western portion of the proposed pipeline route crosses an ephemeral channel that drains to Boulder Creek. The Sheep Creek channel extends to the south-southwest and ends on an alluvial fan approximately 4 miles east of Boulder Creek. Sheep Creek has one short reach of year-round flow approximately 1 mile south of the Leeville Project area (**Figure 3-6**). Rodeo Creek drains to the northwest and joins Boulder Creek approximately 7 miles from the Project site. Rodeo Creek also has a few short channel segments that have flow year-round due to shallow groundwater inflow.

The Tuscarora Mountains extend north-south and separate Boulder, Rock, Antelope, and Willow creeks on the west from Maggie, Marys, and Susie creeks to the east (**Figure 3-5)**. The Leeville Project area is located on the immediate west flank of the mountain divide. The Sheep Creek Range separates Boulder Creek from Rock Creek. Maggie, Susie, and Marys creeks flow southward to the Humboldt River near the town of Carlin, approximately 20 miles southeast of the Leeville Project area (**Figure 3-5**).

All streams in the immediate Project area are ephemeral or intermittent, the former with flow occurring primarily in response to significant precipitation events or snow-melt runoff, and the latter flowing mainly in wetter months when the water table is higher and in contact with the stream. Peak flow typically occurs during March, April, May, or June. Stream segments that typically have year-round measurable baseflow are shown on **Figure 3-6**. Most reaches with perennial flow are located in the upper headwater mountainous areas. Where flow does occur in area streams, baseflow rates are in the range of 1 to 3 cubic feet per second (cfs) or less.

The TS Ranch Reservoir receives mine discharge water from the dewatering system at Barrick's Goldstrike Property. This reservoir is located approximately 5 miles west of the Leeville Project area (**Figure 3-6**) and is at the terminus of the proposed pipeline and canal system for the Leeville dewatering system. The majority of the water in the TS Ranch Reservoir infiltrates to underlying bedrock through a fault/fracture system. Operation of the reservoir is based on an agreement between Newmont and Barrick.

Up to 69,000 gallons per minute (gpm) or 154 cfs (minus process water) have been discharged from the Goldstrike Property dewatering system to an irrigation system, during the irrigation season (i.e., April to early October) using about 75 irrigation pivots and a flood irrigation system (**Figure 3-5**). Most of the pivots are used to irrigate TS Ranch land owned by Newmont in the Boulder Flat area. During the non-irrigation season (i.e., late October through March), excess mine water is discharged to infiltration basins, injection wells, and/or the TS Ranch Reservoir (**Figure 3-5**). Barrick discharged treated water to the Humboldt River from its mine dewatering operations from September 1997 to February 1999. Water was treated to reduce total dissolved solids (TDS) and cooled to meet effluent limitations.

Dewatering for the Goldstrike Property began in 1990 and, under current plans, will continue through 2010. Groundwater pumping rates for the Goldstrike Property, Gold Quarry, and Leeville mines (past and future rates) are shown graphically on **Figure 3-7**. Water management information for these mines is summarized in **Table 3-11**.

Dewatering from the Gold Quarry Mine began in 1992 and has ranged from 4,000 to 20,000 gpm (9 to 45 cfs), with an expected future rate averaging 10,000 gpm (**Figure 3-7**). The rate for fourth quarter 1999, was 7,045 gpm. The discharge water enters lower Maggie Creek and then the Humboldt River after cooling, with some water stored in the Maggie Creek Ranch Reservoir during peak spring runoff. Water in the reservoir is used for crop irrigation in the Maggie Creek Valley or is discharged to Maggie Creek. Dewatering at Gold Quarry is expected to continue through 2011.

Rodeo Creek

Approximately two-thirds of the Leeville Project area shown on **Figure 3-6** is contained in the upper Rodeo Creek drainage; the remaining third of the Project area is in the Sheep Creek drainage. Both Rodeo and Sheep creeks are located in the Boulder Flat Hydrographic Area. Intermittent flow in Rodeo Creek occurs primarily in the middle section of the stream as a result of groundwater discharge from springs and seeps (Welsh Engineering 1989). Newmont and Barrick constructed a diversion on Rodeo Creek in 1993 to allow expansion of the Betze/Post pit. Rodeo Creek is monitored monthly by Barrick at four sites (RC-AA, RC-A, RC-B and RC-C; **Figure 3-6)**.

A surface water flow hydrograph for one of the Rodeo Creek stations (RC-C) is presented on **Figure 3-8**; seasonal variations in flow shown on this hydrograph are similar to the other three monitoring sites on Rodeo Creek. In general, Rodeo Creek is dry except during the spring period of March through June (Barrick 1998). Heavy precipitation in the spring of 1993 and 1996-97 resulted in streamflow rates of up to 1,300 gpm (2.9 cfs) in the upper portion of Rodeo Creek, and up to 12,000 gpm (27 cfs) in lower Rodeo Creek (Barrick 2000). Peak flow rates measured during other years in the period of record are about half the maximum values reported above for Rodeo Creek. The Rodeo Creek channel typically is narrow and entrenched to depths of 4 to 24 feet. The lower reaches of Rodeo Creek show evidence of sedimentation (BLM 1991). This creek drains a total area of approximately 19.4 square miles.

Brush and Bell creeks are two primary tributaries of Rodeo Creek located north of the Leeville Project area (**Figure 3-6**). Bell and Brush creeks have perennial flow in the upper reaches and are intermittent in the lower portion of the drainage. The channels of both creeks are entrenched.

Sheep Creek

The eastern portion of the proposed dewatering discharge pipeline for the Leeville Project would extend along the northern end of the Sheep Creek drainage (**Figures 3-1** and **3-5**). Sheep Creek is an intermittent drainage that extends south-southwest toward Boulder Creek. No flow data are available for Sheep Creek; however, a short perennial reach occurs approximately 1 mile south of the Leeville Project area (**Figure 3-6**). When flow occurs in the Sheep Creek channel from significant precipitation events, water normally infiltrates prior to reaching Boulder Creek.

Boulder Creek

Springs that discharge from the Tuscarora Mountains supply water year-round to upper reaches of Boulder Creek. Boulder Creek becomes intermittent approximately 2 miles above its confluence with Rodeo Creek and remains intermittent until it joins Rock Creek (BLM 1993a). As water moves downstream in Boulder Creek from the mountains, it infiltrates and recharges Boulder Valley alluvium. The Boulder Creek channel is about 3 feet deep and 50 feet wide just downstream of its confluence with Rodeo Creek. The channel consists primarily of cobbles and gravel with minor amounts of silt (BLM 1991).

Figure 3-5

blANK

Figure 3-6

blank

Figure 3-7

blank

Figure 3-8

blank

TABLE 3-11
Water Management for Major Mines in the Carlin Trend, Nevada

Condition	Major Mine Site: Goldstrike Property	Major Mine Site: Gold Quarry Mine	Major Mine Site: Leeville Mine
Pumping Periods and Rates			
Start of Active Dewatering (year)	1990	1992	2002[2]
Planned End of Dewatering (year)	2010	2012	2020[2]
Max. Projected Dewatering Rate (gpm)[1]	69,000	25,000	25,000
Note: See **Figure 3-7** for projected pumping rates over time.			
Groundwater Drawdown			
Premining Groundwater Surface at Mine (feet above mean sea level)	5,265	5,100	5,267
Max. Drawdown End of 1998 (feet)	1,527	658[3]	360[4]
Maximum Planned Drawdown (feet)	1,689	1,375[3]	1,467
Pumped and Reinfiltration Volume			
Total Planned Pumped Volume at Closure (acre-feet)	1,085,000	595,000	360,000[6]
Total Planned Reinfiltration Volume at Closure (acre-feet)	564,000	16,700[5]	212,000
Humboldt River Discharge[7]			
Start of Discharge (year)	1997	1994	2002[2]
End of Discharge (year)	1999	2011	2005[2]
Estimated Max. Rate (gpm)	56,810	23,800	25,000
Period of Peak Discharge (year)	1997	2000	2003[2]
Total Discharge Volume End of 1998 (acre-feet)	72,000	77,000	0
Total Planned Discharge Volume at Closure (acre-feet)	81,000	442,000	47,000

1. gpm = gallons per minute
2. Revised date based on personal communication (Pettit 2001).
3. Includes approximately 76 feet of drawdown that occurred from pumping between 1988 and 1992.
4. Drawdown has resulted from pumping at the Goldstrike Property and Gold Quarry mine.
5. Preliminary estimate only.
6. Revised volume of pumped groundwater at Leeville Mine based on average annual rates shown on **Figure 3-7**.
7. Leeville Mine is not expected to discharge excess water to the Humboldt River, but has a contingency to do so with approval from the State Engineer (per Ruling 5011). Discharge to Humboldt River from Gold Quarry Mine is via Maggie Creek.

Source: BLM 2000a.

The USGS operates gaging station No. 10324700 on Boulder Creek approximately 1 mile downstream of the Rodeo Creek confluence (**Figure 3-6**). Drainage area for this Boulder Creek station is 77 square miles (USGS 2000). For the period of record (1991 to 2000), there was no flow at this station from July through December. Mean monthly flow for January, February, March, April, May, and June for the period 1991 to 1999 is 5.2, 7.7, 15.1, 13.9, 18.6, and 2.0 cfs, respectively (USGS 2000). A hydrograph showing flow variations at the Boulder Creek USGS station from 1991 through 2000 is shown on **Figure 3-8**.

Barrick measures flow monthly in Boulder Creek at four stations (BC-AA, BC-A, BC-B, and BC-C), the first three of which are shown on **Figure 3-6.** The fourth station is located about 5 miles downstream from BC-B. The USGS station on Boulder Creek discussed above is located near station BC-B (**Figure 3-6**). Annual peak flow rates for the four Boulder Creek stations range from 62 to 85 cfs (Desert Research Institute 1998). In 1994, flow occurred only at upper station BC-AA (February through June), ranging from 0.2 to 9 cfs. JBR Consultants Group (1990a) calculated peak flow for flood events in Boulder Creek (at Rock Creek) for the following recurrence intervals: 2-year = 1,200 cfs;

5-year = 3,300 cfs; 10-year = 4,400 cfs; 25-year = 7,000 cfs; 50-year = 9,500 cfs; and 100-year = 12,700 cfs. For the period 1991-2000 at USGS gaging station on Boulder Creek, highest daily mean flow was 350 cfs (**Figure 3-8**) and instantaneous peak flow was 440 cfs (USGS 2000).

Rock Creek

Rock Creek flows south from Squaw Valley through the Sheep Creek Range into the Boulder Valley (**Figure 3-5**). Rock Creek drains approximately 864 square miles. The USGS operates a stream gaging station (No. 10324500), which has been in continuous operation since 1946, at the mouth of the canyon where Rock Creek exits the Sheep Creek Range. Mean annual flow in Rock Creek for the period of record is 41.7 cfs at the USGS gaging station (USGS 2000). Maximum and minimum flows at the gaging station were 4,800 cfs (in 1962) and 0 cfs, respectively. Although Rock Creek provides virtually no base flow to the Humboldt River due to infiltration and evapotranspiration, it does contribute significant runoff to the Humboldt River during snowmelt and major precipitation events (HCI 1999b). Barrick (2000) also monitors flow in Rock Creek at three additional stations (RKC-1, RKC-2, and RKC-3) located upstream of the USGS gaging site (RKC-4). Flow at the three upper stations is intermittent, but occurs most of the year at rates typically in the range of 1 to 20 cfs.

Maggie Creek

East of the Tuscarora Mountains, Maggie Creek flows to the south where it enters the Humboldt River near the town of Carlin (**Figure 3-5**). Maggie Creek Basin is divided into upper and lower basins by Maggie Creek Canyon, or “the Narrows.” Baseline flow data show that Maggie Creek is generally perennial above the Narrows and intermittent downstream from the Narrows where surface flow infiltrates into alluvial sediments. Mine dewatering discharge from Newmont’s Gold Quarry Mine is piped to Maggie Creek below the Narrows; this source of water to Maggie Creek has ranged from 4,000 to 20,000 gpm (Newmont 1999b). Total drainage area for Maggie Creek is 396 square miles.

Flow data for Maggie Creek currently are obtained by the USGS at three stations -- two upstream of Gold Quarry discharge just below the Narrows (USGS No. 10321950; Newmont station MAG-3) and above the Narrows (USGS No. 10321940; Newmont station MAG-5), and another near the mouth of the creek (USGS No. 10322000; Newmont station MAG-1) where it joins the Humboldt River. **Table 3-12** summarizes flow data for two of these stations, including mean annual, maximum, minimum, and mean monthly flow. Mean annual natural flow in Maggie Creek at all three gaging stations for individual years in the period of record prior to April 1994 ranges from 1.8 to 47 cfs (USGS 2000). Stream flow at this site has been influenced by mine dewatering discharges from Gold Quarry since April 1994. A hydrograph of Maggie Creek flow at the lower station for the period 1992 through 2000 is included on **Figure 3-9**.

Marys Creek

Marys Creek flows under Interstate 80 and past Carlin Springs before entering the Humboldt River southwest of Carlin. Marys Creek is intermittent above Carlin Springs but flows perennially below the springs to its confluence with the Humboldt River. The USGS has operated a continuous stream gaging station (USGS No. 10322150; Newmont Station Marys-0)) on Mary’s Creek below Carlin Springs since November 1989. Drainage area of Marys Creek above the gaging station (distance of 0.7 mile above confluence with Humboldt River) is 45 square miles (USGS 2000). Maximum flow in Marys Creek at the gaging station was 530 cfs, and lowest daily mean flow was 0.6 cfs (USGS 2000). Mean annual flow ranges from 2.8 to 9.4 cfs for individual years in the period of record 1990 to 1998 (USGS 2000). Flow at the gaging station typically declines sharply in April or May as a result of the end of spring runoff. The town of Carlin also obtains some municipal water from the springs, which affects flow at the gaging station.

Susie Creek

One USGS gaging station (No. 10321590) is located near the mouth of Susie Creek and has been recording flow data since April 1992. The drainage area above this gage is 194 square miles (USGS 2000). Mean annual flow for individual years in the period of record has ranged from 1.7 to 21 cfs (USGS 2000). A peak

Figure 3-9

blank

flow of 561 cfs was measured at this site on March 16, 1997. Susie Creek periodically becomes dry in the lower section, primarily during the months of July, August, and September. Newmont (2001) also monitors Susie Creek at the USGS gage site (SCS-6), as well as at five more stations farther upstream (SCS-1 through SCS-5).

Humboldt River

Several USGS gaging stations are located along the Humboldt River upstream, downstream, and adjacent to the Carlin Trend area. Humboldt River gaging station No. 10325000 is located near the town of Battle Mountain approximately 2 miles below where Rock Creek joins the Humboldt River. Another USGS gaging station (No. 10321000) is located upstream of the Maggie Creek confluence near the town of Carlin (Newmont station HUM-1). Flow data for these two Humboldt River stations are summarized in **Table 3-12**. Mean annual flow at these upstream and downstream stations for the period of record through 1999 is 385 and 376 cfs, respectively (USGS 2000). **Figure 3-9** presents a hydrograph of flow variations in the Humboldt River at the Battle Mountain station for the period 1991 through 2000.

Two additional USGS gaging stations are located between the Carlin and Battle Mountain stations: No. 10322500 at Palisade and No. 10323425 at Dunphy. Baseflow data (i.e., October mean flow) indicate that flow increases in the Humboldt River between the Carlin and Palisade gaging stations, and decreases between the Palisade and Dunphy gaging stations (BLM 2000a). Estimated baseflow in the Humboldt River is 16.6 cfs at the Carlin gage and 32.3 cfs at Palisade (HCI 1999a). Gains and losses in river flow in this area are exaggerated by mine discharge water and irrigation withdrawals. Gold Quarry Mine has discharged at a rate of 4,000 to 20,000 gpm to Maggie Creek upstream from Carlin. Discharge to the Humboldt River also occurred periodically from the Goldstrike Property at rates of up to 66,000 gpm between 1997 and 1999 (**Table 3-11**).

CHANNEL GEOMETRY AND FLOODPLAINS

In the vicinity of Barrick's permitted discharge outfall, the Humboldt River is a sinuous point-bar channel and has maintained this configuration since 1979 (BLM 2000b). Channel bed slope is approximately 6 feet per mile in this portion of the river. Channel banks typically are steep and consist primarily of very-fine grained sand, silt, and clay. Bed materials consist predominantly of gravel and sand, with a mean grain size of 20 millimeters (BLM 2000b).

The Federal Emergency Management Agency (FEMA 1982) and BLM (1991) have delineated the 100-year floodplain along Boulder Creek below its confluence with Rodeo Creek. West of the Project area, the floodplain for Boulder Creek is relatively narrow, typically less than 500 feet wide. The 100-year floodplain of upper Boulder and Rodeo creeks has not been delineated; however, the floodplain in these areas is generally narrower than the lower reaches. Floodplain width of the Humboldt River is in the range of about 2000 to 4000 feet. Three bridges cross the river in the vicinity of Dunphy.

TABLE 3-12
Flow Data for Maggie Creek and Humboldt River

Time Period	Flow Rates (cubic feet per second)					
	Maggie Creek Upstream (#10321950)	Maggie Creek Downstream (#10322000)[1]		Humboldt River Upstream Near Carlin (#10321000) [2]	Humboldt River Midway at Palisade (#10322500) [2]	Humboldt River Downstream Near Battle Mountain (#10325000)[2]
Mean Annual	22.5	23.4	31.6	385	403	376
High Daily Mean	520	750	750	8,090	7,820	5,800
Low Daily Mean	0	0	0	0.2	2.0	0
Mean Monthly						
Jan	12	4.5	18	142	148	189
Feb	14	17	26	272	289	293
Mar	66	64	78	523	596	528
Apr	69	97	101	729	865	778
May	65	87	93	1,011	1,024	924
Jun	22	19	27	1,283	1,215	1,136
Jul	3.4	3.0	6.9	364	353	376
Aug	1.4	2.1	4.9	55	62	51
Sep	1.9	1.9	4.8	27	37	18
Oct	3.7	3.6	8.5	45	60	32
Nov	5.1	3.8	11	76	89	74
Dec	5.9	2.9	11	99	107	110
Period of Record	1989-1999	1913-1993[3]	1913-1999[3]	1943-1999	1903-1999	1897-1999[3]
Number of Years in Record	10	10	16	56	92	48

[1]Maggie Creek downstream station (10322000) has been influenced by mine dewatering discharges 6 miles upstream since April 1994.
[2]The Humboldt River has many diversions for irrigation.
[3]No data available from this station from October 1, 1924 to April 27, 1992.

Source: USGS 2000

WATER QUALITY STANDARDS

Nevada water is regulated for quality standards that have been established by the State of Nevada under Nevada Water Pollution Control regulations and statutes (Nevada Administrative Code [NAC] 445A.070 et seq.; Nevada Revised Statutes [NRS] 445A.300 et seq.). Water quality criteria for designated beneficial uses (i.e., irrigation, livestock watering, aquatic life, recreation, municipal or domestic supply, industrial supply, and propagation of wildlife) are summarized on **Table 3-13**; these standards include those for toxic materials that may be applicable to the Leeville Project. Narrative standards applicable to all water in the state are specified in NAC 445A.121-122. Streams and rivers in Nevada are classified as Class A, B, C, or D with Class A streams of highest quality and Class D streams of lowest quality (NAC 445A.123-127). Tributaries of Maggie Creek are designated Class A and the upper portion of Maggie Creek is Class B. Class C reaches include the lower portion of Maggie Creek and Rock Creek. The Humboldt River in the study area is Class C. Other streams in the study area are not classified. Standards for stream classes A, B, and C are summarized in **Table 3-14**.

TABLE 3-13
Water Quality Criteria and Standards for Nevada

Parameter[1] (mg/L), unless specified otherwise	Federal Drinking Water Standard		Nevada Municipal or Domestic Supply	Aquatic Life[4]		Agriculture		Wildlife Propagation
	Primary MCL[2]	Secondary MCL[2]		1-Hr Average or Propagation	96-Hr Average or Put and Take	Irrigation	Stock Water	
Antimony	0.006		0.146					
Arsenic	0.05	--	0.05	0.342 As(III)	0.18 As(III)	0.1	0.2	--
Barium	2.0	--	2.0	--	--	--	--	--
Beryllium	0.004	--	0	--	--	0.1	--	--
Boron	--	--	--	--	--	0.75	5.0	--
Cadmium	0.005	--	0.005	0.0053[3]	0.0013[3]	0.01	0.05	--
Chromium	0.10	--	0.10	0.015 Cr(VI)	0.01 Cr(VI)	0.1	1.0	--
Copper	1.3	1.0	--	0.0221[3]	0.0142[3]	0.2	0.5	--
Iron	--	0.3[0.6]	--	1.0	1.0	5.0	--	--
Lead	0.015	--	0.05	0.0684[3]	0.0013[3]	5.0	0.1	--
Manganese	--	0.05[0.1]	--	--	--	0.2	--	--
Mercury	0.002	--	0.002	0.002	.000012	--	0.01	--
Molybdenum	--	--	--	0.019	0.019	--	--	--
Nickel	0.1	--	0.0134	1.699[3]	0.189[3]	0.2	--	--
Selenium	0.05	--	0.05	0.020	0.005	0.02	0.05	--
Silver	--	--	--	0.0069[3]	0.0069[3]	--	--	--
Thallium	0.002	--	0.013	--	--	--	--	--
Zinc	--	5.0	--	0.140[3]	0.127[3]	2.0	25.0	--
Cyanide (WAD)	0.2	--	0.2	0.022	0.0052	--	--	--
Alkalinity	--	--	--	less than 25% change		--	--	30-130
Chloride	--	250[400]	250[400]	--	--	--	1,500	1,500
Color (PCU)	--	15	75	--	--	--	--	--
Dissolved Oxygen	--	--	Aerobic	5.0	5.0	--	Aerobic	Aerobic
Fluoride	4.0	2.0	--	--	--	1.0	2.0	--
Nitrate as N	10	--	10	90(w)	90(w)	--	100	100
pH (SU)	--	6.5-8.5	5.0-9.0	6.5-9.0	6.5-9.0	4.5-9.0	5.0-9.0	7.0-9.2
Sulfate	--	250[500]	250[500]	--	--	--	--	--
Temp° C	--	--	--	Site specific determination		--	--	--
TDS	--	500[1000]	500[1,000]	--	--	--	3,000	--
TSS	--	--	--	25-80	25-80	--	--	--
Turbidity (NTU)	1.0	--	--	50(w);10(c)	50(w);10(c)	--	--	--

[1]mg/L = milligrams per liter; PCU = photoelectric color units; SU = standard pH units; NTU = nephelometric turbidity units; TDS = total dissolved solids; TSS = total suspended solids; °C = degrees Celsius. WAD = weak acid dissociable. Standards for metals are expressed as total recoverable, except those metals that are hardness-dependent where the standard applies to the dissolved fraction (see note #3 below).
[2] MCL = Maximum Contaminant Level. Numbers in brackets [ ] are mandatory secondary standards for public water systems.
[3]Parameter dependent on hardness; see NAC 445A.144 for equations to determine concentration; values in this table calculated assuming a hardness of 150 mg/L as $CaCO_3$. Example: Cadmium 1-hour average = 0.85 exp {1.128 in (hardness) – 3.828} = 0.85 exp {1.824} = 0.85 (6.2) = 5.3 µg/L = 0.0053 mg/L.
[4](w) = warm water; (c) = cold water; no letter designation indicates criteria are common to both warm and cold water.

Source: Nevada Administrative Code 445A.119 and 144.

TABLE 3-14
Water Quality Standards for Class A, B, and C Streams in Nevada

Item	Class A Specification	Class B Specification	Class C Specification
Floating Solids or Sludge Deposits	None attributed to human activities	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
Odor-Producing Substances	None attributed to human activities	See Nevada Administrative Code 445A.125	Not Specified
Sewage, Industrial Wastes, or Other Wastes	None allowed	None that are not effectively treated to the satisfaction of the NDCNR	None that are not effectively treated to the satisfaction of the NDCNR
Toxic Materials, Oil, Deleterious Substances, Colored or Other Wastes	None allowed	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
Settleable Solids	See Nevada Administrative Code 445A.124	See Nevada Administrative Code 445A.125	See Nevada Administrative Code 445A.126
pH	Range between 6.5 and 8.5	Range between 6.5 and 8.5	Range between 6.5 and 8.
Dissolved Oxygen	Must not be less than 6.0 milligrams per liter (mg/L)	For trout water, not less than 6.0 mg/L; for nontrout water, not less than 5.0 mg/L	For water with trout, not less than 6.0 mg/L; for water without trout, not less than 5.0 mg/L
Temperature	Must not exceed 20° C; allowable temperature increase above natural receiving water temperature: None	Must not exceed 20° C for trout water or 24° C for nontrout water; allowable temperature increase above natural receiving water temperatures: None	Must not exceed 20° C for trout water or 34° C for nontrout water; allowable temperature increase above normal receiving water temperatures: 3° C
Total Phosphates	Must not exceed 0.15 mg/L in any stream at the point where it enters any reservoir or lake, nor 0.075 mg/L in any reservoir or lake, nor 0.30 mg/L in streams and other flowing water	Must not exceed 0.3 mg/L	Must not exceed 1.0 mg/L
Total Dissolved Solids	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)	Must not exceed 500 mg/L or one-third above that characteristic of natural conditions (whichever is less)

NDCNR = Nevada Department of Conservation and Natural Resources

Source: Nevada Administrative Code 445A.124-205.

Water quality standards for Humboldt River control points at the Palisade Gage and Battle Mountain Gage are presented in **Table 3-15**. Standards assigned to the Humboldt River apply to all surface water in the watershed upstream from the control point or to the next upstream control point; these standards consist of selected nonmetal parameters such as temperature, pH, chloride, nitrate, total dissolved solids, and total suspended solids. Groundwater quality may not be lowered below state or federal standards for drinking water (NAC 445A.424).

Nevada's Section 303(d) list (Clean Water Act) for development of "total maximum daily loads" (TMDLs) includes the Humboldt River. In general, a waterbody was included on the 303(d) list if the beneficial use standards were not met more than 25 percent of the time. There are existing TMDLs for total phosphorous and total suspended solids on the Humboldt River from Palisade to Battle Mountain (NDEP 1998). There is a high priority of TMDL development assigned by NDEP to the Humboldt River.

TABLE 3-15
Beneficial Use Water Quality Standards for Humboldt River at Palisade Gage and Battle Mountain Gage Control Points

Parameter[1] (mg/L, unless specified otherwise)	Water Quality Standards for Beneficial Uses[2]	Most Restrictive Beneficial Use
Temp (ºC)	$\Delta T \leq 2^{o}$ C [3]	Aquatic life (warm water fishery)
pH (standard units)	6.5 – 9.0 ΔpH $\forall$ 0.5	Water contact recreation; wildlife propagation
Dissolved Oxygen	$\geq$ 5.0	Aquatic life (warm water fishery)
Chlorides	$\leq$ 250	Municipal or domestic supply
Total Phosphorus (as P)	$\leq$ 0.1	Aquatic life (warm water fishery)
Nitrate	$\leq$ 1.0	
Nitrite	$\leq$ 10	Municipal or domestic supply
Ammonia (un-ionized)	$\leq$ 0.02	
TDS	$\leq$ 500	Municipal or domestic supply
TSS	$\leq$ 80	Aquatic life (warm water fishery)
Sulfate	$\leq$ 250	Municipal or domestic supply
Sodium (SAR)	$\leq$ 8	Irrigation
Color (PCU)	No adverse effects	Municipal or domestic supply
Turbidity (NTU)	$\leq$ 50	Aquatic life (warm water fishery)

1 mg/L = milligrams per liter; ^{o}C = degrees Celsius; P = phosphorous; TDS = total dissolved solids; TSS = total suspended solids; SAR = sodium adsorption ratio; PCU = photoelectric color units; NTU = nephelometric turbidity units. Limits apply from the control point upstream to the next control point.

2 Δ = change; all values are single-value measurements, except total phosphorus as seasonal average, TDS and SAR as annual averages, and TSS as annual median. $\leq$ = less than or equal to; $\geq$ = greater than or equal to

3 Maximum allowable increase in temperature at the boundary of an approved mixing zone.

Source: Nevada Administrative Code 445A.204-205

Waste discharges to any state water must be such that no impairment of beneficial use occurs as a result of the discharge (NAC 445A.120[2]). Permits are required from the Nevada Department of Conservation and Natural Resources (NDCNR) for anyone intending to discharge to state water (NAC 445A.228-263; NRS 445.221). Limits on certain quality parameters of the water are established for a discharge permit.

SURFACE WATER QUALITY

Barrick currently collects water samples from four surface water stations on Rodeo Creek (RC-AA, RC-A, RC-B, and RC-C) and four stations on Boulder Creek (BC-AA, BC-A, BC-B, and BC-C) on a monthly basis (**Figure 3-6**). These data are reported semi-annually in the Boulder Valley Monitoring Plan reports (Barrick 2000). Newmont also samples five Rodeo Creek sites on a quarterly basis as part of its Water Pollution Control Permit in the North Operations Area. Newmont's analytical data have been submitted to NDEP on a quarterly basis since 1997. In addition, the USGS collects water quality data at its station on Boulder Creek located approximately one mile downstream of the Rodeo Creek confluence near station BC-B (**Figure 3-6**).

Surface water near the Leeville Project area generally is a calcium-bicarbonate type with pH in the range of 7.5 to 8.5 standard units. With the exception of a few parameters (e.g., chloride and arsenic), surface water in Rodeo Creek and Boulder Creek is similar in quality (**Table 3-16**). Quality of water in Rock Creek has been monitored periodically since 1995 at the four stations established by Barrick (2000). Rock Creek has chemical characteristics similar to Rodeo and Boulder creeks. Sulfate in Rock Creek generally is in the range of 20 to 40 milligrams per liter (mg/L).

A review of surface water quality data in the Leeville area shows that arsenic is elevated throughout Rodeo Creek, but is relatively low in the tributaries of Brush and Bell creeks. The elevated arsenic concentrations in Rodeo Creek probably are due to a combination of natural arsenic in the mineralized areas and increases from exposure and weathering of rock from mining-related disturbed areas. Concentrations of arsenic in the uppermost Rodeo Creek Station (RC-AA), which is located above most mining-related disturbance, are similar to concentrations measured at other Rodeo Creek stations located farther downstream.

Surface water quality is also monitored periodically by Newmont, Barrick, USGS, and NDEP in Maggie Creek, Marys Creek, Susie Creek, and the Humboldt River in the Carlin Trend area. Samples generally are collected on a quarterly basis and reported quarterly by Newmont (2001) in the Maggie Creek Basin Monitoring Plan reports, and annually by the USGS (2000) in the Water Resources Data - Nevada Water Year Reports. Data obtained by NDEP are reported in STORET (STORET numbers for NDEP stations are: Maggie Creek station HS14 = 310583; Humboldt River near Palisade station HS6 = 310082; Humboldt River at Battle Mountain station HS7 = 310083) (NDEP 1998). STORET is an EPA database of chemical and physical water quality parameters at over 750,000 locations across the United States. The Maggie Creek sample sites are located upgradient and downgradient of the Maggie Creek Canyon, and near the creek's confluence with the Humboldt River. Stations on Marys Creek and Susie Creek monitored by Newmont are located near the mouth of these drainages.

Newmont's Humboldt River sample sites are located at Carlin, Palisade, and Battle Mountain gages. The Humboldt River station near Carlin (No. 10321000) is sampled by the USGS six times per year as part of its National Stream Quality Accounting Network (NASQAN) and National Water Quality Assessment (NAWQA) program. The program established specifically for the Carlin Trend includes seven stream gaging stations, 15 sites for miscellaneous streamflow measurements, one site for surface water quality, and 25 wells for water level measurements as required by the Nevada State Engineer.

Water quality characteristics of Boulder, Rodeo, and Maggie creeks, and the Humboldt River are summarized below because they are primary drainages near the Project. Other streams in the study area (i.e., Rock, Marys, and Susie creeks) have similar quality characteristics that are reported by Newmont (2001) and Barrick (2000).

Boulder Creek

Representative water quality data collected from Boulder Creek at stations BC-AA (upstream) and BC-B (downstream) are presented in **Table 3-16**. Concentrations of metals (e.g., arsenic, iron, and manganese) are higher at the downstream station (BC-B) on Boulder Creek. Some arsenic concentrations at the lower station do not meet aquatic life and domestic supply standards (**Tables 3-13** and **3-16**).

Rodeo Creek

Table 3-16 contains representative analytical results from surface water in Rodeo Creek at stations RC-AA (immediately downstream of the Leeville Project) and RC-B (approximately 5 miles downstream of the Leeville Project). Average concentrations of arsenic (0.097 and 0.148 mg/L) at both Rodeo Creek stations do not meet standards for aquatic life and domestic water supply. Iron concentrations often exceed the aquatic life standard.

Maggie Creek

Water in Maggie Creek upstream of the Gold Quarry Mine discharge point at Newmont station MAG-3 (USGS No. 10321950) exhibits low concentrations of common ions and metals (Newmont 2000). Arsenic ranges from about <0.005 to 0.03 mg/L. Iron concentrations often exceed the aquatic life standard. At the lower station near the mouth of Maggie Creek (Newmont station MAG-1; USGS No. 10322000), water quality is similar to the upper station (**Table 3-16**). Dissolved oxygen at both Maggie Creek stations is in the range of 8 to 10 mg/L (Newmont 2000).

Humboldt River

Humboldt River water in the study area is consistent in quality (i.e., between upstream Carlin monitoring site and downstream Battle Mountain site). Quality of river water at the middle station (HUM-5 at Palisade) is summarized in **Table 3-16**. This surface water contains low concentrations of most chemical constituents. Arsenic concentrations in the river range from 0.002 to 0.02 mg/L. Dissolved oxygen in the Humboldt River generally is between 4 and 11 mg/L. Sodium adsorption ratios are low (1 to 2) (USGS 2000). Sediment yield in the Humboldt River at Carlin is about 14 and 605 tons per day for flow rates of 100 and 1,000 cfs, respectively (BLM 2000b).

SPRINGS AND SEEPS

Numerous springs and seeps have been identified in the study area, primarily north of the Leeville Project area on the flanks of the Tuscarora Mountains (**Figure 3-10**). On the west side of this mountain range, springs typically form the head-water of Rodeo, Brush, Bell, and Boulder creeks. Most of the springs are small and often flow only part of each year at rates up to 5 gpm. The source for many of these mountain springs, especially above an elevation of about 6,000 feet, is believed to be primarily perched groundwater not connected to the regional water table (Desert Research Institute 1998; BLM 1991, 1993a; Leggette, Brashears & Graham, Inc. 1993). Locations of these springs generally are controlled by topography and/or geologic formation.

A comprehensive spring and seep inventory in the North and South Operations Areas was conducted by Riverside Technology, Inc. (RTI 1994) during September and October 1993. Additional springs/seeps have been identified by the USGS (1968), JBR Consultants Group (in Newmont 1998), and BLM (1997a). **Figure 3-10** shows springs/seeps in the Leeville Project area. Four springs have been identified within the Leeville Project boundary, whereas approximately 75 springs/seeps have been inventoried along the portion of the Tuscaloosa Range shown on **Figure 3-10**.

Infiltration of water from the TS Ranch Reservoir resulted in creation of three new springs (Green, Knob, and Sand Dune springs) about 3 to 5 miles south of the reservoir and southwest of the Leeville Project area (**Figure 3-10**). Water discharging from these three springs is collected in the Sand Dune Canal and conveyed to the infiltration and/or irrigation systems.

Selected springs are monitored quarterly or semi-annually by Newmont in the North and South Operations Areas. Results of this monitoring program show springs can be categorized into three basic groups: water of a

TABLE 3-16
Surface Water Quality – Leeville Project Area

Parameter [2]	Sample Sites [1]						Standards for Municipal or Domestic Supply[3]
	Boulder Creek (BC-AA)	Boulder Creek (BC-B)	Rodeo Creek (RC-AA)	Rodeo Creek (RC-B)	Maggie Creek at Mouth (MAG-1)	Humboldt River at Palisade (HUM-5)	
Sample Period	1/93 – 3/99	1/93 – 3/99	3/93 – 6/98	1/93 – 6/98	3/93 – 3/99	3/93 – 3/99	---
No. Samples	41	24	19	15	24	24	---
TDS							
Range	72 – 250	86 – 220	130 – 534	198 – 1090	222 – 410	170 – 372	500 – [1000]
Mean	145	142	208	370	330	293	
TSS							
Range	<0.1 – 323	6 – 460	6 – 1300	14 – 361	1.6 – 1100	3 – 1200	---
Mean	45	87	202	120	101	188	
pH (std units)							
Range	7.1 – 8.4	7.7 – 8.2	7.1 – 9.3	7.7 – 8.7	7.8 – 9.2	7.3 – 8.7	5.0 – 9.0
Mean	7.8	7.9	8.0	8.1	8.5	8.2	
Total Alkalinity							
Range	22 – 100	41 – 76	30 – 160	75 – 180	100 – 253	130 – 220	---
Mean	64	60	66	120	196	197	
Calcium							
Range	9 – 42	10 – 45	11 – 63	27 – 141	36 – 65	32 – 66	---
Mean	20	19	21	49	50	48	
Sodium							
Range	5.2 – 12	4.9 – 13	9.2 – 25	12 – 47	19 – 74	6 – 52	---
Mean	10	8.4	17	21	34	34	
Magnesium							
Range	3.4 – 17	4.0 – 21	3.7 – 78	14 – 40	14 – 32	0.05 – 20	---
Mean	7.6	7.3	21	29	20	13	
Potassium							
Range	<1.5 – 4.3	1.2 – 11	2.9 – 29	2.7 – 12	5.8 – 15	2.4 – 11	---
Mean	2.6	3.1	5.9	5.0	9.1	7.4	
Chloride							
Range	1.9 – 7.0	1.9 – 22	6 – 177	6.8 – 421	10 – 25	6 – 25	250 – [400]
Mean	3.6	5.9	28	75	15	16	
Fluoride							
Range	0.1 – 1.2	0.2 – 0.3	0.1 – 0.4	0.2 – 0.9	<.05 - .08	0.33 – 0.7	---
Mean	0.3	0.3	0.3	0.5	0.6	0.5	
Sulfate							
Range	7 – 100	8.4 – 47	12 – 47	23 – 162	47 – 82	15 – 61	250 – [500]
Mean	29	22	30	75	59	40	
Nitrate							
Range	<.05 – .54	<.05 - .66	<.05 – 1.5	0.33 – .88	<.05 - <.10	<.05 - <.10	10
Mean	0.12	0.21	0.53	0.54	0.05	0.06	
Arsenic							
Range	<.001 - .003	.002 - .505	.037 – 1.38	.024 - .542	<.005 - .033	0.002 - .02	0.05
Mean	0.003	0.028	0.148	0.097	0.015	0.015	
Iron							
Range	0.03 – 23	0.2 – 89	0.12 – 150	0.15 – 30	<.01 – 30	0.04 – 36	0.3 – [0.6] (s)
Mean	1.94	9.2	12.0	4.1	1.4	2.1	
Manganese							
Range	.002 - .282	.002 – 1.06	.008 – 2.81	.002 - .71	<.005 - .93	<.005 - .65	0.05 – [0.10] (s)
Mean	0.041	0.11	0.30	0.13	0.09	0.13	

[1] See **Figure 3-6** for sampling sites on Boulder and Rodeo creeks
[2] All units in milligrams per liter (mg/L) unless otherwise specified; TDS = total dissolved solids; TSS = total suspended solids; NR = no record. Concentrations are total. For statistical purposes, values reported as less than the laboratory detection limit were set equivalent to the value.
[3] Numbers in brackets [ ] are mandatory secondary standards for public water systems; values with an (s) are federal secondary drinking water standards. See **Table 3-13** for a listing of water quality standards.
Source: Barrick (2000); Newmont (2000).

Figure 3-10

blank

non-thermal origin; thermal water; and anomalous water with elevated major ions and trace metals (Newmont 1997b). Concentrations of trace metals and major ions generally are slightly higher in the thermal springs than the non-thermal springs. Most springs in the vicinity of the Leeville Mine site are non-thermal.

Water from springs in the study area exhibits neutral to basic pH (6.4 to 8.9 standard units), specific conductance (SC) ranging from about 100 to 800 micromhos per centimeter (µmhos/cm), nitrate concentrations of less than 3.2 mg/L, and sulfate ranging from <10 to 230 mg/L (RTI 1994). Total dissolved solids range from 30 to 550 mg/L, with lowest concentrations at higher elevations in the Tuscarora Mountains. Concentrations of metals in spring water throughout the area generally are low. Temperature of springs in the area ranges from 38 to 78° F.

GROUNDWATER QUANTITY

Groundwater in the Project area moves through siltstone and carbonate rocks along the Tuscarora Mountains and then into basin fill deposits and volcanic rocks in the Boulder, Rock, and Willow Creek valleys (west side) and Maggie Creek Valley (on the east side) (Maurer et al.1996). In some areas, the siltstone and carbonate rocks are confined by overlying, older basin fill deposits. Carbonate rocks are unconfined where exposed at land surface. In general, carbonate rocks are the most permeable material in the area. Shallow alluvial deposits of interbedded sand and gravel are found in drainage bottoms at thicknesses of up to 50 feet. Groundwater movement generally is down the valleys; however, mine dewatering and discharge in the Carlin Trend has influenced direction of flow in some areas.

Precipitation in the mountain ranges is the primary source of groundwater recharge in the Project area. The USGS estimates that for an area with 12 to 15 inches per year (in/yr) of precipitation, which is typical for the Leeville area (see **Table 3-7**), approximately 7 percent of total precipitation recharges groundwater from infiltration (Maurer et al. 1996). For areas with 8 to 12 in/yr and 15 to 20 in/yr of precipitation, estimated percentage of precipitation that infiltrates to groundwater is 3 percent and 15 percent, respectively (Maurer et al. 1996).

Evapotranspiration of groundwater is limited to areas where water levels are sufficiently shallow to influence plant water uptake (i.e. phreatophytes) or bare soil. The following evaportranspiration rates for plant types have been used by the USGS in the study area: 3.6 in/yr for greasewood; 6 in/yr for a mixture of shrubs; 7 in/yr for a mixture of shrubs and grasses; and 12 in/yr for grasses and willows in wet meadows and irrigated areas (Maurer et al 1996).

Leeville Project Area

The Leeville Project gold deposits are hosted primarily by Paleozoic-age carbonate rocks. Two primary hydrostratigraphic units occur in the study area: (1) shallow, unconfined siltstone or “upper plate”; and (2) deep, generally confined carbonate system or “lower plate”. The shallow and deep flow systems apparently interact to a limited degree, but do not function as a single hydrogeologic unit. Numerous monitoring wells/ piezometers have been installed in the vicinity of the Leeville Project to obtain information on groundwater conditions (**Figure 3-11**). Nineteen monitoring wells are located within or near the Project boundary (**Figure 3-12**).

A complex system of north-south trending high-angle faults occur in the Leeville Project area (**Figure 3-10**). These faults can act as both conduits and barriers to groundwater flow, depending on the openings and alteration associated with the structures. Based on results of water level monitoring and aquifer testing, some faults in the vicinity of the Leeville Project area appear to act as barriers to groundwater flow; see **Figure 3-10** for locations of selected faults. Drawdown in the carbonate rocks at Leeville has been relatively constant over the past few years due to dewatering at the Goldstrike Property and to a lesser degree, the Gold Quarry Mine, suggesting that the rocks are part of a bounded system created by barrier faults.

A geothermal system is evident in the study area, conceptualized as a very deep groundwater flow system (HCI 1999a). Permeable fractures and faults associated with ore deposits allow upwelling of geothermal water from depth which mixes with shallower groundwater in the vicinity of the mines.

Dewatering at the Goldstrike Property and Gold Quarry mine are described above under the *Surface Water Quantity* section. Groundwater levels have been lowered by over 1,500 feet in the vicinity of the Goldstrike Property (BLM 2000b). The Leeville Project area is located between two cones of depression caused by dewatering at the two mine sites (**Figure 3-11**).

Prior to initiation of mine dewatering, groundwater generally flowed southwest from the west side of the Tuscarora Mountains to Boulder Creek, and then along the Boulder Valley toward the Hum-boldt River (BLM 2000a). On the east side of the mountains, groundwater moved east-southeast toward Maggie Creek and the Humboldt River. Current groundwater flow in the Leeville Project area remains to the southwest (**Figure 3-11**) because of its location between the two major mine drawdown areas.

Figure 3-13 presents a hydrogeologic cross-section through the Leeville Project area that shows approximate water table elevations during first quarter 2000. Completion data for monitoring wells at the Leeville site are presented in **Table 3-17.** At the proposed Leeville Mine shaft site, the water table in the upper plate rocks is approximately 250 to 500 feet below ground surface (elevation of about 5,700 feet), with a vertical downward gradient of about 0.7 foot/foot (HCI 1998). Hydraulic head encountered in the lower plate is at an elevation of about 4,800 to 4,900 feet.

Groundwater in the Leeville Project area has been declining at a relatively constant rate since large-scale dewatering began at the Goldstrike Property and Gold Quarry mine. According to monitoring by Newmont (2001), water levels in wells completed in upper plate rocks near the Leeville Project generally have declined between 60 and 265 feet over the period of record (1993 to 2000), while water levels in lower plate rocks have dropped up to 369 feet during the same time period (**Table 3-17**). As shown on **Figure 3-13**, the hydraulic head in the lower plate in the Leeville Project area has been lowered below the contact between the upper and lower plates, resulting in unconfined conditions.

During 1996, Newmont conducted aquifer tests in some of the wells installed at the Leeville Project area. Testing involved completion of static spinner, dynamic spinner, step drawdown, and constant discharge tests. The spinner tests were employed to document vertical gradients across a formation and identify discrete water-producing zones within a formation, while the step drawdown tests and constant discharge tests were conducted to determine well efficiencies, aquifer parameters, and identify aquifer boundaries. Aquifer test results indicate hydraulic conductivity of the upper plate rocks (siltstone; pumping well HDDW-3) ranging from 0.6 to 5.2 feet/day with a geometric mean of 1.7 feet/day (HCI 1998). Using pumping well HDDW-1A in the lower plate rocks (carbonate), hydraulic conductivity is in the range of 80 to 96 feet/day with a geometric mean of 89 feet/day (HCI 1998).

For Carlin Trend modeling purposes, HCI (1999a) used the following hydraulic conductivity values: 0.025 to 0.5 feet/day for regional siltstone; 50 to 100 feet/day for carbonates in upper Boulder Flat; 0.13 to 0.25 feet/day for Tertiary-age sediment in upper Boulder Flat; and 10 feet/day for alluvium in Boulder Flat.

Boulder Flat and Rock Creek Valley

Five hydrostratigraphic units occur in Boulder Flat and the Rock Creek Valley. The shallowest unit is Quaternary-age basin-fill alluvium. Underlying the alluvium, in descending order, are: Tertiary-age basin-fill sediments known as the Carlin Formation; Tertiary-age volcanic rocks; Paleozoic-age siltstone (upper plate); and Paleozoic-age carbonate rocks (lower plate). Alluvium is limited to areas along stream channels and across the floor of Boulder Flat. Tertiary-age sediment in the Boulder Flat area contains tuffaceous sand and gravel, interbedded with siltstone and claystone. This sediment package is up to 4,000 feet thick and overlies Tertiary-age volcanic and Paleozoic-age siliciclastic rocks (HCI 1999a). In upper Boulder Flat, groundwater flows toward the drawdown area caused by dewatering at the

Figure 3-11

blank

Figure 3-12

blank

Figure 3-13

blank

TABLE 3-17
Monitoring Well Completion and Water Level Elevation Data at the Leeville Project Site

Well No.	Total Depth (ft)	Screen Interval (ft)	Formation Plate	Initial GW Elev. (ft)	Initial Measure-ment Date	Last Monitored Elev. (ft)	Last Measure-ment Date	Water Level Drawdown to Date (ft)
CG-74	2340	2220-2240	Lower	4961.9	6-20-97	4807.1	9-29-00	154.8
HDP-1D	1830	1800-1820	Lower	5213.7	7-19-95	5111.4	3-31-00	102.3
HDP-2S	1520	1280-1300	Lower	5057.6	6-23-95	4811.2	9-27-00	246.4
HDP-4	500	480-500	Upper	5804.3	8-8-96	5735.4	9-29-00	68.9
HDP-5	1005	980-1000	Upper	5553.7	8-9-96	5289.0	9-29-00	264.7
HDP-6	520	500-520	Upper	5791.8	8-8-96	5732.1	12-22-00	59.7
HDP-7	520	500-520	Upper	5799.0	8-8-96	5727.1	12-22-00	71.9
HDP-8	2100	2030-2050	Lower	5982.4	1-13-97	NA	NA	NA
HDP-9	2940	2890-2930	Lower	4988.6	1-27-97	5006.7	3-30-00	+18.1
HDP-13S	2250	1508-1528	Upper	5789.3	6-23-97	5725.5	9-29-00	63.8
HDP-13D	2250	2220-2240	Lower	4960.1	6-24-97	4812.7	9-29-00	147.4
NHD-11	1363	1319-1359	Lower	5458.9	7-7-92	5212.0	6-8-99	246.9
NHD-44	1015	995-1015	Upper	5422.1	8-30-93	5304.6	12-7-00	117.5
NHD-74	2000	1979-1999	Lower	5196.9	10-13-94	4827.5	12-22-00	369.4
NHD-76D	1869	1849-1869	Lower	5100.4	10-18-94	4816.2	9-29-00	284.2
NHD-76S	1869	830-850	Upper	5789.8	10-13-94	5590.5	9-29-00	199.3
NHD-78	1766	1530-1550	Lower	5079.9	3-8-95	4816.3	9-27-00	263.6
RKP-1S	1762	720-740	Upper	5541.5	7-18-95	5647.6	9-27-00	+106.1
RKP-2	1550	1528-1548	Lower	4987.2	12-27-96	4821.1	9-29-00	166.1

Note: See **Figure 3-12** for well locations. Ft = feet; GW = groundwater; Elev. = elevation; NA = not available.

Source: Newmont 2000, 2001.

Goldstrike Property. Groundwater flow parallels Boulder Creek in lower Boulder Flat except near the TS Ranch Reservoir, where a groundwater mound has developed as a result of seepage from the reservoir.

Maggie Creek Area

The same five hydrostratigraphic units present in Boulder Flat are in the Maggie Creek area. In this area, the uppermost water table system is hosted by sediments of Quaternary-age alluvium, the Carlin Formation, and Tertiary-age volcanics. The groundwater system generally flows to the southeast parallel to Maggie Creek (Plume 1994). Groundwater in deeper siltstone (upper plate) and carbonate (lower plate) rocks flows toward the Gold Quarry pit as a result of mine dewatering.

GROUNDWATER QUALITY

Leeville Project Area

Groundwater quality in the Leeville Project area has been characterized by analysis of water samples from three aquifer test wells installed at the Leeville Project (wells DDW-1A, HDDW-2, and HDDW-3, **Figure 3-12**). Groundwater quality analytical results from the three wells are presented in **Table 3-18.** With the exception of arsenic in the upper and lower plate units, concentrations of all parameters are below Nevada's primary drinking water standards (**Tables 3-13** and **3-18**). Arsenic concentrations exceed the state drinking water standard (0.05 mg/L) in the wells during all sampling events. Highest arsenic concentrations occur in well HDDW-2 (0.508 to 0.726 mg/L), screened in lower plate carbonate rocks. Elevated arsenic concentrations in groundwater in the Leeville area likely represent natural levels in deep mineralized zones.

TABLE 3-18
Groundwater Quality in Vicinity of Leeville Project

Parameter[1]	Well HDDW-1A		Well HDDW-2		Well HDDW-3		Standards for Municipal or Domestic Supply[2]
No. of samples	4		4		4		---
Hydrostratigraphic Unit	Lower Plate (Popovich / Roberts Mtn Formations)		Lower Plate (Rodeo Ck / Popovich / Roberts Mtn Formations)		Upper Plate (Vinini Formation)		---
Statistics	Range	Mean / SD[3]	Range	Mean / SD[3]	Range	Mean / SD[3]	---
TDS	233 – 305	266 / 37.1	233 – 321	275 / 44.1	229 - 241	233 / 5.3	500 – [1000]
SC (μmhos/cm)	367 – 372	369 / 2.6	494	494 / NM	NA	NA / NA	---
pH (std units)	7.20 - 8.17	7.9 / 0.47	8.08 – 8.16	8.15 / 0.07	7.83 - 8.07	7.95 / 0.13	5.0 – 9.0
Temperature (º F)	86 – 87	86.5 / NM	67 – 70	68.5 / NM	59 – 63	61 / NM	---
Alkalinity (as HCO_3)	137 – 146	140 / 4.1	179 – 185	182 / 3.1	109 – 138	118 / 13.9	---
Calcium (Ca)	39.7 – 42.2	40.4 / 1.2	48.6 – 51.9	49.9 / 1.5	33.0 - 39.0	37.3 / 2.9	---
Sodium (Na)	6.5 – 10	7.5 / 1.7	9.0 - 13.1	10.8 / 1.8	9.0 - 10.4	9.6 / 0.71	---
Magnesium (Mg)	19.1 – 19.5	19.2 / 0.2	18.7 – 20.2	19.5 / 0.7	14.0 - 15.6	14.7 / 0.79	125 – [150] (s)
Potassium (K)	2.9 - 3.0	2.95 / 0.06	3.0 - 4.0	3.43 / 0.42	3.0 - 3.4	3.1 / 0.2	---
Chloride (Cl)	6.9 - 7.7	7.2 / 0.35	8.8 - 12.5	10.5 / 1.52	6.1 - 7.7	6.8 / 0.67	250 – [400]
Fluoride (F)	0.32 – 0.33	0.32 / 0.005	0.79 - 0.84	0.81 / 0.026	0.42 - 0.53	0.45 / 0.05	2.0(s) - 4.0
Sulfate (SO_4)	44.6 - 45.5	45 / 0.38	65.0 – 72.2	68.2 / 3.01	62.6 - 70.0	65.8 / 3.2	250 – [500]
Nitrate as NO_3-N	<0.02 - <0.10	0.04 / 0.02	<0.10	0.05 / 0	<0.10	0.05 / 0	10
Antimony (Sb)	0.007	0.007 / NM	0.015 - 0.030	0.023 / 0.006	<0.005	0.0025 / 0	0.146
Arsenic (As)	0.057 - 0.068	0.061 / 0.005	0.508 - 0.726	0.628 / 0.104	0.097 - .572	0.348 / 0.22	0.05
Boron (B)	<0.10	0.05 / 0	<0.10	0.05 / 0	<0.10	0.05 / 0	---
Cadmium (Cd)	<0.005	0.0025 / 0	<0.005 - 0.009	0.004 / 0.003	<0.005	0.0025 / 0	0.005
Chromium (Cr)	<0.05	0.025 / 0	<0.05	0.025 / 0	<0.05	0.025 / 0	0.10
Iron (Fe)	0.14 - 0.32	0.21 / 0.08	0.37 - 0.39	0.38 / 0.008	0.17 – 4.69	2.25 / 2.14	0.3 – [0.6] (s)
Manganese (Mg)	<0.01 - 0.01	0.006 / 0.003	0.06 - 0.08	0.068 / 0.01	0.18 – 0.32	0.395 / 0.08	0.05 – [0.10] (s)
Mercury (Hg)	<0.001	0.0005 / 0	<0.001	0.0005 / 0	<0.001	0.0005 / 0	0.002
Selenium (Se)	<0.001 - .005	.0016 / 0.002	<0.001 - 0.004	0.0018 / 0.002	<.001 - .004	0.0018 / 0.0017	0.05
Zinc (Zn)	<0.01 - 0.01	.0075 / 0.003	<0.01 - 0.06	0.0188 / 0.028	0.03 - 0.09	0.05 / 0.028	5.0 (s)

Note: Samples were collected and analyzed during the period April 1996 – August 1997. See **Figure 3-12** for well locations.

[1] All units in milligrams per liter (mg/L) unless otherwise specified. Metals are dissolved concentrations. SC = specific conductance in micromhos per centimeter; TDS = total dissolved solids; NA = not analyzed.

[2] Numbers in brackets [ ] are mandatory secondary standards for public water systems. Values with an (s) are federal secondary drinking water standards. See **Table 3-13** for a listing of water quality standards.

[3] SD = standard deviation; NM = not measured. For statistical purposes, values reported by the laboratory at less than the detection limit were converted to half the specified limit value.

Source: Newmont 1996, 1997b.

Iron and manganese concentrations were elevated with respect to federal secondary drinking water standards (**Table 3-18**), especially in the upper plate well. Iron and manganese concentrations decreased as aquifer testing progressed, indicating possible influence from steel well casing. Water temperatures range from approximately 60°F in upper plate rocks to 87°F in lower plate rocks.

WATER USE

Water in the study area is used for irrigation, stock watering, mining/milling, and domestic purposes. Irrigation and stock watering uses are scattered throughout the Boulder Valley, whereas mining and milling uses occur primarily in upper reaches of Boulder and Rodeo creeks drainages where most of the active mines are located (e.g., Betze/Post Mine). Other nearby mining and milling water uses are located on the east side of the Tuscarora Mountains in the South Operations Area (i.e., Gold Quarry Mine). Most domestic uses are associated with various mine operations.

Mine-Related Water Use

A summary of groundwater pumping rates for the Goldstrike Property, Gold Quarry, and Leeville mines are presented graphically on **Figure 3-7**. Information relative to water management at these mines is presented in **Table 3-11**. Relatively minor groundwater pumping and consumption (less than 100 gpm) also occurs at several other mines in the north Carlin Trend area (e.g., Genesis and Deepstar mines). Long-term water consumption from evaporation of pit lake water will occur at some of the mine pits; however, this would not occur for the Leeville underground mine.

The proposed Leeville Project is expected to pump groundwater at rates of up to 25,000 gpm for the first 2 years of operation, declining to a rate of about 15,000 gpm in the following 2 years (**Figure 3-7**). Approximately 8,000 to 10,000 gpm would be pumped at the mine site during the final 10 years of operation.

For the Goldstrike Property and Gold Quarry mine, maximum groundwater pumping rates of about 69,000 gpm and 25,000 gpm, respectively, have been used to dewater the mines. Current pumping rates at Goldstrike Property and Gold Quarry mine are approximately 40,000 and 10,000 gpm, respectively. These rates are expected to remain the same or decline for the remaining mine life (**Figure 3-7**). Approximately 2,000 to 2,500 gpm is consumed for mine-related activities at each of the major mine sites. The remainder of water at the Goldstrike Property is discharged to infiltration basins and the TS Ranch Reservoir. Injection wells are occasionally used in the Boulder Valley, but have scaling problems that preclude frequent use.

Excess water at Gold Quarry is discharged to Maggie Creek, including a temporary storage reservoir (Maggie Creek Ranch Reservoir). Barrick maintains a permit to discharge excess water from their dewatering system at Goldstrike Property to the Humboldt River if necessary, but has not done so since February 1999. Active dewatering would continue through year 2010 for the Goldstrike Property and through year 2012 for Gold Quarry. Additional water supply needs of 1,000 to 2,000 gpm would be needed for 5 to 10 years after cessation of mining for post-closure and reclamation activities at each major mine.

Water Rights

Maps and lists of surface water and groundwater rights for the study area are provided in the Cumulative Impact Analysis report (BLM 2000a). Within a 3-mile radius of the Leeville Project site, there are three water supply wells with water rights that are not associated with mining and milling activities: (1) Permit No. 23881; Certificate No. 7642; Newmont Gold Company; T35N, R50E, NW¼ of Section 22, for stock uses; (2) Permit No. 26873; Certificate No. 8659; Elko Land and Livestock Co.; T35N, R50E, NE¼ of Section 20, for stock uses; and (3) Permit No. 28969; Certificate No. 9282; Elko Land and Livestock Co.; T36N, R50E, SE¼ of Section 30; for stock uses. There are no surface water rights listed within 3 miles of the Leeville site; however, numerous water rights are held by Barrick for the TS Ranch Reservoir at T35N, R49E, NW¼ of Section 3 (various water uses). In addition, two water rights for irrigation are held by A.C. Fox for Boulder Creek approximately downgradient of the Leeville Project site (T35N, R49E, NE¼ & SW¼ of Section 8).

SOILS

Soil resources in the soil survey study area, inclusive of the two alternative pipeline routes, were mapped as an Order II survey in the fall of 1997 by Resource Concepts, Inc. (RCI 1998). Information contained in the Order III Soil Survey of Tuscarora Mountain Area, Nevada completed by the Natural Resource Conservation Service (NRCS) in 1980 was used as the basis for the Order II soil survey. The soil survey study area is shown on **Figure 3-14** and soil map units are described in **Table 3-19**.

Soil resources in the area were evaluated for potential use in reclamation of disturbed areas using the criteria from Part 620.06f, Table 620-11 of the National Soil Survey Handbook (NRCS 1993) as a guide. The physical and chemical properties of soil that pertain to suitability as a growth medium were determined in the field and by FGL Environmental in Santa Paula, California. The properties were used as the basis to formulate a recommendation for salvage depth and volume of suitable growth medium. The Tuscarora Mountain Area Soil Survey (NRCS 1980) was consulted to determine potential erosion hazards from water and wind.

Soil series from the Order II map units and characteristics are listed in **Table 3-20** and shown on **Figure 3-14**. Data collected from the Order II Soil Survey include soil series identified, percent of soil series included in each mapping unit, slope range, landform, depth to induration or bedrock, depth of soil suitable for reconstruction material/soil salvage, rooting restricting depth, and parent material. Permeability, available water holding capacity, surface runoff class, and erosion hazard potential were taken from the existing Order III Soil Survey.

Depth of soil varies throughout the soil survey area, as indicated in **Table 3-19** and **Table 3-20**. Shallow soil is found along ridge lines and weathered slopes (**Figure 3-14**). Map units 02 and 03, although located in upland areas, exhibit soil depth dominantly ranging from 20 to 40 inches. Soil depth in the lowlands (map units 09 and 10) is moderately deep to very deep. Except for soil occupying drainages, soil in the Leeville Project area is well drained and not subject to saturated conditions. Soil in the Project area has very low available water capacity, and very slow to moderate permeability, with surface runoff ranging from very slow to rapid, primarily depending on degree of slope.

The major soil component(s) in an undisturbed state for each soil map unit within the Project area were used to evaluate potential for use as reclamation material. The NRCS (1993) guide rates suitability of soil using the major properties that influence erosion and stability of the surface and the productive potential of reconstructed soil. Those properties and ratings of soil identified in the soil survey are presented in **Table 3-19**. Soil reconstruction of disturbed areas is the process of replacing layers of soil material or unconsolidated geologic material, or both, in a vertical sequence of such quality and thickness that a favorable plant growth medium results.

Soil is rated in its current state, whether it is a natural or previously modified state. Only the most restrictive properties are evaluated for interpretation. The properties are listed in descending order of estimated importance.

A rating of “good” means that vegetation is relatively easy to establish and maintain, that the surface is stable and resists erosion, and that the reconstructed soil has good potential productivity.

Material rated as fair can be vegetated and stabilized by modifying one or more properties. Top dressing with better material or application of soil amendments may be necessary for satisfactory performance.

Soil may be unsuitable for specific uses if it has one or more restrictive properties. Restrictive properties are physical or chemical characteristics that inhibit plant growth or make the soil structurally unsound. Soil properties considered most important when rating soil for use as salvage material include: soil texture, depth to bedrock (duripan), coarse fragment content (greater than 3 inches in diameter), salt content, and pH. Features such as steep slopes, rough terrain, and rock outcrop may limit access for salvage activities.

Soil map unit components identified in the study area were rated for salvage potential based on physical and chemical properties of the soil profiles described in the field, and laboratory analysis (**Table 3-20**). Recommended suitability of soil for salvage is summarized in **Table 3-19**.

Soil mapping units have been assigned a rating of good, fair, or poor based on the most limiting characteristic of any map unit component. Coarse fragment content and/or shallow depth to a restrictive layer are the most common limiting characteristics for salvage potential of soil in the study area. Using the most limiting characteristics of any map unit component, 2.5 to 5 feet of one map unit - Map Unit 10 (except rock outcrop), could be salvaged and stockpiled for reclamation purposes. The majority of map units rate as poor overall (**Table 3-19**). Salvage potential in Map Unit 03 and Map Unit 09 is high at 98 percent and 94 percent, respectively, if it is cost effective to restrict these activities to the primary components of those map units. The second component of Map Unit 04, the Slaven soil (30 percent) is conducive to salvage. In total, approximately 4 million cubic yards of native soil are conducive to salvage within the study area.

Ten of the 14 soil map units identified in the Leeville Project area rate as poor for one of the following properties: too cobbly, too stony, or thin layer. These properties are 11th, 12th and 13th in order of estimated importance of the 16 properties evaluated. The remaining properties are rated as good or fair for soil reconstruction material.

Figure 3-14

blank

TABLE 3-19
Suitability of Soil for Salvage In the Soil Survey Area

Soil Map Units	Soil Series	Limiting Characteristic	Recommended Soil Salvage Depth (feet)	Potential Soil Salvage Area (acres)	Growth Medium Salvage Volume (cubic yards)	Salvage Rating
01	Tusel (68%)	Too cobbly 40% of 3-10" dia. Thin layer 10-22"	0	0	0	Poor
	Chen (30%)	Cobbly 30-40% 3-10" dia.	0	0	0	Poor
	Rock outcrop (2%)	Not Applicable (NA)	NA	NA	NA	NA
02	Primeaux (98%)	Too stony 30% of >10"	0	0	0	Poor
	Welch (2%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
03	Pie Creek (98%)	Thin layer approx. 33"	2.5	86	346,867 [1]	Good
	Welch (2%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
04	Chen (60%)	Thin layer 10 – 22" Cobbly 30-40% 3-10" dia.	0	0	0	Poor
	Slaven (30%)	Thin layer approx. 32"	Approx. 2.5	130	524,333 [2]	Fair
	Rock outcrop (10%)	NA	NA	NA	NA	NA
05	Chiara (85%)	Thin layer approx. 17"	0	0	0	Poor
	Short Creek (15%)	Too stony 20% >10" dia.	0	0	0	Poor
06	Mosquet (96%)	Thin layer 11 to 18"	0	0	0	Poor
	Chen (2%)	Limited extent	0	0	0	Poor
	Coff (2%)	Limited extent	0	0	0	Poor
07	Welch (96%)	Too cobbly 55% of 3-10" dia.	0	0	0	Poor
	Chen (2%)	Limited extent	0	0	0	Poor
	Denay (2%)	Limited extent	0	0	0	Poor
08	Coff (50%)	Too cobbly 60% of 3-10" dia.	0	0	0	Poor
	Denay (30%)	Too cobbly 20-70% of 3-10" dia.	0	0	0	Poor
	Mascamp (10%)	Too cobbly 20-70% of 3-10" dia.	0	0	0	Poor
	Rubble Land (5%)	Thin layer 11-23"	0	0	0	Poor
	Rock Outcrop	NA	NA	NA	NA	NA
09	Cherry Spring (94%)	None	2.5	520	2,097,333 [3]	Good
	Coff (4%)	Too cobbly 60% of 3-10" dia.	0	0	0	Poor
	Humdun loam (2%)	Limited extent	0	0	0	Poor
10	Humdun (90%)	None	5	116	935,733	Good
	Cherry Spring (8%)	None	2.5	10	40,333	Good
	Rock outcrop (2%)	NA	NA	NA	NA	NA
		TOTALS		**862[4]**	**3,944,599[5]**	

Note: dia. = diameter. Not all soil series shown in Table 3-19 would be disturbed by the Proposed Action.

[1] Restrict salvage to Pie Creek Soil
[2] Restrict salvage to Slaven Soil
[3] Restrict salvage to Cherry Spring Soil
[4] Total acres in soil survey area in which soils have the potential to be used in reconstruction of disturbed sites
[5] Represents total volume of suitable soil available in the soil survey area.

Source: NRCS 1980, 1993; RCI 1998.

TABLE 3- 20
Physical and Chemical Properties of Soil in the Soil Survey Area

Soil Map Unit Component	Depth (in)	USDA Texture[1]	Permeability (in/hr)	Available Water Capacity (in/in)	Salinity (mmhs/cm)	Shrink-Swell Potential	Erosion Factors Surface Layer		pH (Standard Units)
							K[2]	T[3]	
Chen	0 – 8 8 – 11 17 – 21	cbL, VgrL grC bedrock	0.6 - 2.0 0.0 - 0.06 0.0 - 0.01	0.13 – 0.15 0.07 – 0.09	0 0 0	Low Moderate	0.17	1	6.6 -7.8 6.6 -7.8
Cherry Spring	0 – 15 15 –36 36 – 60	SiL L, SiL, CL Duripan	0.6 - 2.0 0.2 - 0.6 0.0 - 0.01	0.19 – 0.21 0.17 -0.19	0 0	Low Low	.55	2	6.6 -7.8 7.4 - 9.0
Chiara	0 – 4 4 – 13 13 – 17	SiL SiL, CL Duripan	0.6 - 2.0 0.6 - 2.0 0.0 - 0.01	0.19 -0.21 0.16 -0.18	0 – 2 0 – 4	Low Low	.55	1	6.6 -8.4 6.6 -9.0
Coff	0 – 5 5 – 29 29 – 39	VgrSiL VgrSiL Duripan	0.6 - 2.0 0.6 - 2.0	0.09 -0.11 0.09 -0.11	0 0	Low Low	.17	2	7.9 -8.4 7.9 -8.4
Denay	0 – 10 10 – 60	grL XgrL	0.6 - 2.0 0.6 - 2.0	0.15 -0.17 0.09 -0.11	0 0 – 2	Low Low	.24	3	7.4 -8.4 7.9 -8.4
Humdun	0 – 8 8 – 30 30 – 60	SiL L SiL	0.6 - 2.0 0.6 - 2.0 0.6 - 2.0	0.19 – 0.21 0.17 -0.20 0.17 -0.20	0 0 2 – 4	Low Low Low	.49	5	6.6 - 7.8 6.6 - 8.4 7.9 -9.0
Mascamp	0 – 7 7 – 15 15 – 25	XstSL VcbSCL Bedrock	2.0 - 6.0 0.6 - 2.0 0.0 - 0.01	0.08 -0.11 0.08 -0.11	0 0	Low Mod	.20	1	6.1 -7.3 6.1 -7.3
Mosquet	0 – 5 5 – 14 14 – 24	VgrSL grCL Bedrock	2.0 - 6.0 0.06 - 0.2 0.0 - 0.01	0.06 -0.08 0.13 -0.15	0 0	Low High	0.10	1	6.1 -7.3 6.1 -7.3
Pie Creek	0 – 5 5 – 21 21 – 35 35 – 45	L C C Bedrock	0.6 - 2.0 0.0 - 0.06 0.06 - 0.2 0.0 - 0.01	0.16 -0.18 0.14 -0.16 0.16 -0.19	0 0 0 – 2	Low High High	.37	2	6.6 -7.3 6.6 -7.3 7.4 -8.4
Primeaux	0 – 11 11 – 20 20 – 35 35 – 45	grL CL VgrSCL Bedrock	0.6 - 2.0 0.2 - 0.6 0.6 - 2.0 0.0 - 0.01	0.10 -0.18 0.15 -0.19 0.15 -0.17	0 0 0	Low Moderate Low	.32	2	6.1 -7.3 6.6 -7.3 6.1 -7.3
Short Creek	0 – 8 8 – 23 23 – 60	grCL VgrC XgrC-SCL	0.6 - 2.0 0.06 - 0.2 0.0 - 0.01	0.07 -0.09 0.08 -0.11	0 0	Low Moderate	.24	5	6.6 -7.3 6.6 -7.3 7.9 -9.0
Slaven	0 – 5 5 – 22 22 – 32	VgrL XgrC-CL Bedrock	0.6 - 2.0 0.06 - 0.2 0.0 - 0.01	0.07 -0.09 0.08 -0.11	0 0	Low Moderate	.28	2	6.1 -7.3 6.6 -7.3
Tusel	0 – 17 17 – 60	VgrL XgrSCL-CL	0.6 - 2.0 0.2 - 0.6	0.13 -0.15 0.08 -0.11	0 0	Low Moderate	.24	5	6.1 -7.3 6.1 -7.3
Welch	0 – 7 7 – 60	L grCL	0.6 - 2.0 0.2 - 0.6	0.16 -0.20 0.18 -0.20	0 0	Low Moderate	.32	5	6.1 -7.3 6.1 -7.3

[1] cbL = cobbly loam; VgrL = very gravelly loam; grC = gravelly clay; SiL = silt loam; L = loam; CL = clay loam: VgrSiL = very gravelly silt loam; grL = gravelly loam; XgrL = extremely gravelly loam; XstSL = extremely stony sandy loam; VcbSCL = very cobbly sandy clay loam; VgrSL = very gravelly sandy loam; grCL = gravelly clay loam; C = clay; VgrSCL = very gravelly sandy clay loam; VgrC = very gravelly clay; XgrC-SCL = extremely gravelly clay - sandy clay loam; XgrC-CL = extremely gravelly clay – clay loam; XgrSCL-CL = extremely gravelly sandy clay loam-clay loam.

[2] K = Soil Erodability Factor. The higher the value, the more erodable the soil.

[3] T = Tons per acre of tolerable soil loss without reducing crop production.

Source: NRCS 1980.

VEGETATION

Vegetation in the Leeville Project area is dominated by sagebrush steppe communities, with limited riparian vegetation bordering drainages, springs, and seeps. Big sagebrush dominates on deep, salt-free soil, along with bluebunch wheatgrass, Thurber needlegrass, and Sandberg bluegrass (Cronquist et al. 1972). The vegetation study area corresponds to the soil survey area.

In general, vegetation in the Project area reflects historic and ongoing disturbance by mining, grazing, and fire. Areas cleared of sagebrush, either mechanically or by wildfire, have generally converted to annual plant communities dominated by cheatgrass, unless previously seeded to adapted wheatgrass species. Riparian vegetation is sparse and infrequent with some willows or herbaceous riparian species along ephemeral drainages.

Vegetation located within the Project area is identified by the range site and presented in **Table 3-21**. These vegetation types were located and field-verified during the Order II Soil Survey (RCI 1998). Soil map units were correlated to range site descriptions published in the Tuscarora Mountain Area Soil Survey (NRCS 1980) and summarized below (NRCS 1992).

The **Loamy 8 to 10 inch precipitation zone (p.z.)** range site occurs on alluvial fans, low terraces, low foothills, sideslopes, and uplands on slopes ranging from 2 to 50 percent, but most commonly on slopes of 4 to 30 percent. Elevations range from 4,500 to 6,000 feet above mean sea level (AMSL). Dominant plant species include Wyoming big sagebrush, bluebunch wheatgrass, and Thurber needlegrass. Total vegetative canopy cover for this site ranges between 20 to 30 percent. The potential vegetation composition (by weight) for the site is 65 percent grasses, 5 percent forbs, and 30 percent shrubs. This range site constitutes 5 percent of the Project area.

The **Loamy 10 to 12 inch p.z.** range site occurs on sideslopes and summits of alluvial fans and hills on all exposures. Slopes range from 4 to 15 percent. Elevations for this site are 5,500 to 6,500 feet AMSL. Vegetation is dominated by an assemblage of sagebrush species, including basin big sagebrush, Wyoming big sagebrush, and mountain big sagebrush. Other dominant species include antelope bitterbrush, rabbitbrush, bluebunch wheatgrass, Thurber needlegrass, and bluegrass species. Total vegetation canopy cover approaches 30 to 40 percent. Based on dry weight production, potential vegetation compo-sition for this site is 65 percent grasses, 10 percent forbs, and 25 percent shrubs. This range site constitutes 4 percent of the Project area.

TABLE 3-21
Leeville Project Area Range Sites

Range Site	Percent of Mapped Area	Area (acres)
Loamy 8 to 10 inch precipitation zone	5	161
Loamy 10 to 12 inch precipitation zone	4	130
Cobbly claypan 8 to 12 inch precipitation zone	10	304
Claypan 10 to 12 inch precipitation zone	3	86
Shallow loam 8 to 10 inch precipitation zone	1	39
Shallow calcareous loam 8 to 10 inch precipitation zone	6	195
South slope 8 to 12 inch precipitation zone	1	30
Loamy slope 12 to 16 inch precipitation zone	24	754
Loamy bottoms 8 to 14 inch precipitation zone	1	40
Mountain ridge	4	136
Rock outcrop, rubble land	5	167
Annual ephemeral species	36	1,136
Total	**100 %**	**3,178**

Source: RCI 1998.

The **Cobbly Claypan 8 to 12 inch p.z.** range site occurs on hills, erosional fan remnants, and rock- pediment remnants on all aspects. Slopes range from 2 to 50 percent, but slope gradients of 8 to 30 percent are typical. Elevations range from 5,500 to 7,000 feet AMSL. Dominant plant species include bluebunch wheatgrass, Thurber needle-grass, and low sagebrush. Approximate ground cover (basal and crown) is 10 to 20 percent with potential vegetative composition approaching 55 percent grass, 10 percent forbs, and 35 percent shrubs. This range site constitutes 10 percent of the Project area.

The **Claypan 10 to 12 inch p.z.** range site occurs on summits and sideslopes of hills and alluvial terraces and fans on all aspects. Slopes range from 2 to 50 percent, but gradients of 8 to 30 per-cent are typical. Elevations for this site range from 5,500 to 6,500 feet AMSL. Dominant plant species include low sagebrush, antelope bitterbrush, and rabbitbrush with an understory of bluebunch wheatgrass, needlegrass species and a variety of perennial forb species. Potential vegetation composition by dry weight is 30 percent shrubs, 60 percent grass, and 10 percent forbs. Approximate canopy ground cover is 20 to 30 percent. This range site constitutes 3 percent of the Project area.

The **Shallow Loam 8 to 10 inch p.z.** range site occurs on sideslopes of hills and lower mountains with southern aspects. Slopes range from 8 to 75 percent, but slopes of 15 to 50 percent are most common. The plant community is dominated by Thurber needlegrass, Indian ricegrass, and Wyoming big sagebrush. Approximate ground cover (basal and crown) is 10 to 20 percent. Potential vegetation composition is about 50 per-cent grass, 5 percent forbs, and 45 percent shrubs. This range site comprises approximately 1 percent of the Project area.

The **Shallow Calcareous Loam 8 to 10 inch p.z.** range site occurs on summits and sideslopes of hills and mountains on all aspects. Slopes range from 2 to 50 percent, but slope gradients of 15 to 30 percent are most typical. Elevations range from 5,000 to 6,500 feet AMSL. The plant community on this site is dominated by black sagebrush and Thurber needlegrass. Spiny hopsage and Indian ricegrass are other important species associated with this site. Approximate ground cover (basal and crown) is 15 to 30 percent. Potential vegetation composition by weight for this site is about 50 percent grass, 5 percent forbs, and 45 percent shrubs. This range site constitutes approximately 6 percent of the Project area.

The **South Slope 8 to 12 inch p.z.** range site occurs on mountain sideslopes on all but north exposures. Slopes range from 30 to 75 percent, but slope gradients of 30 to 50 percent are most typical. Elevations are 6,000 to 8,500 feet AMSL. The plant community is dominated by bluebunch wheatgrass although big sagebrush may be prevalent enough to dominate the aspect. Other important plants are antelope bitterbrush, basin wildrye, Nevada bluegrass, and Idaho fescue. Approximate ground cover (basal and crown) is 35 to 45 percent with potential vegetative compo-sition (by weight) approaching 65 percent grass, 10 percent forbs, and 25 percent shrubs. This range site constitutes 1 percent of the Project area.

The Loamy Slope 12 to 16 inch p.z. range site occurs on sideslopes of mountains, hills and fan piedmonts. At lower elevations, this site is restricted to north exposures. Slopes range from 8 to 75 percent, but slope gradients of 15 to 30 percent are most typical. Elevations are 5,500 to 8,000 feet AMSL. The plant community is dominated by Idaho fescue, bluebunch wheatgrass, mountain big sagebrush, and antelope bitterbrush. Slopes of southerly exposure will normally express a higher percentage of bluebunch wheatgrass while north facing slopes support a higher component of Idaho fescue. Big sagebrush is usually prevalent enough to dominate the aspect. Approximate ground cover (basal and crown) is 40 to 50 percent with potential vegetation composition at about 60 percent grass, 15 percent forbs, and 25 percent shrubs. This range site constitutes 24 percent of the Project area.

The **Loamy Bottoms 8 to 14 inch p.z.** range site occurs on the outer margins of axial-stream flood-plains and inset fans. Slopes range from 0 to 8 percent. Elevations are 4,500 to 7,000 feet AMSL. The plant community is dominated by Great Basin wildrye. Other important plants include lupine and basin big sagebrush. Approximate ground cover (basal and crown) is 45 to 60 percent. Vegetation composition is approximately 85 percent grass, 5 percent forbs, and 10 percent shrubs. This range site comprises 1 percent of the Project area.

The **Mountain Ridge** range site occurs on summits, crests, and shoulders of mountains. Slopes are 4 to 75 percent and elevations are 6,000 to 9,500 feet AMSL. The plant community is dominated by Idaho fescue. Other important plants are low and black sagebrush, and bluegrass species. Approximate ground cover (basal and crown) is 15 to 25 percent with potential vegetative composition at about 50 percent grass, 15 percent forbs, and 35 percent shrubs. This range site constitutes 4 percent of the Project area.

Approximately 167 acres, or 5 percent of the Project area, contains miscellaneous land types including rock outcrop and rubble land. These types are not recognized as supporting vegetation types described by NRCS range sites.

Areas dominated by invasive, nonnative plant species are also found within the Project area. These ephemeral vegetation types can occur where the native plant component has been disturbed or otherwise removed such as by fire. Prolific and pervasive annual plant species such as cheatgrass and annual mustard are able to invade and dominate sites, and exclude native perennial species. On drier sites, these invasive communities can become relatively long-lived due to frequent fire and/or disturbance. On wetter sites, native vegetation can often out compete nonnative species and eventually become dominant again. **Table 3-22** lists the dominant plant species observed on or near the Project area during the Order II Soil Survey (RCI 1998).

Thirteen plants classified as Nevada Special Status Species, and designated as sensitive by the Nevada State Office of the BLM, exist or potentially exist on public land within the BLM Elko District. Only one, Lewis buckwheat, potentially occurs in the vicinity of the Project area; it is discussed in the *Threatened, Endangered, Candidate, and Sensitive Species* section of this chapter.

INVASIVE, NONNATIVE SPECIES

Weed species have also been documented in noxious weed inventories near the Project area. Three species of noxious weeds present in the area are Scotch thistle, Canada thistle, and saltcedar (tamarisk) (RCI 1998).

Scotch thistle can grow to eight feet tall and is armed with spines that prevent livestock use in areas of heavy infestation. Seeds remain viable in soil for more than 7 years. Canada thistle reproduces asexually, and is difficult to control. Saltcedar is associated with mesic (dry) sites, and can propagate from buried or submerged stems. Salt can accumulate in this plant, eventually resulting in saline soil and elimination of less salt tolerant vegetation.

Other invasive nonnative species that occur in the vicinity include hoary cress, leafy spurge, diffuse knapweed, and Russian knapweed. Exotic annual grass species, particularly cheatgrass and medusahead wildrye, often dominate native vegetation in many parts of the Great Basin, particularly in areas disturbed by fire (Entiwistle et al. 2000).

Saltcedar is present along Sheep Creek in Section 10, T35N, R50E, and along Boulder Creek, in the Boulder Valley at several injection and monitoring well locations, and along the Humboldt River near Dunphy. Scotch thistle currently exists on previously disturbed and reclaimed exploration sites within the Leeville Project area, along Sheep Creek, Lynn Creek, and the TS Ranch Reservoir. Hoary cress exists along several roads throughout the Boulder Valley (BLM 1993b).

The Natural Resource and Conservation Service is compiling existing BLM, USFS, and state data to delineate extent of noxious weed populations in Nevada.

TABLE 3-22
Plant Species Observed on or Near the Leeville Project Area

Grasses	
Thickspike wheatgrass	*Agropyron dasystachyum*
Western wheatgass	*Agropyron smithii*
Bluebunch wheatgrass	*Agropyron spicatum*
Cheatgrass	*Bromus tectorum*
Basin wildrye	*Elymus cinereus*
Idaho fescue	*Festuca idahoensis*
Indian ricegrass	*Oryzopsis hymenoides*
Sandberg bluegrass	*Poe secunda*
Bottlebrush squirreltail	*Sitanion hystrix*
Needle and thread	*Stipa comata*
Thurber needlegrass	*Stipa thurberiana*
Webber needlegrass	*Stipa webberi*
Forbs	
Aster	*Aster sp.*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Paintbrush	*Castilleja sp.*
Thistle	*Cirsium sp.*
Tapertip hawksbeard	*Crepis acuminata*
Cryptantha	*Cryptantha sp.*
Buckwheat	*Eriogonum sp.*
Goldenweed	*Haplopappus sp.*
Clingingleaf pepperweed	*Lepidium perfoliatum*
White stoneseed	*Lithospermum ruderale*
Lupine	*Lupinus sp.*
Spiny phlox	*Phlox hoodii*
Longleaf phlox	*Phlox longifoiia*
Shrubs	
Serviceberry	*Amelanchier alnifolia*
Low sagebrush	*Artemisia arbuscula*
Black sagebrush	*Artemisia arbuscula nova*
Basin big sagebrush	*Artemisia tridentata tridentata*
Wyoming big sagebrush	*Artmeisia tridentata wyomingensis*
Mountain big sagebrush	*Artemisia vaseyana*
Rubber rabbitbrush	*Chrysothamnus nauseosus*
Douglas rabbitbrush	*Chrysothamnus viscidiflorus*
Spiny hopsage	*Grayia spinosa*
Common pricklygilia	*Leptodactylon pungens*
Antelope bitterbrush	*Purshia tridentata*
Spineless horsebrush	*Tetradymia canescens*
Littleleaf horsebrush	*Tetradymia glabrata*

Source: RCI 1998.

WETLANDS/RIPARIAN ZONES

Four intermittent springs/seeps with seasonal flows up to 5 gpm are located in the Project area (**Figure 3-10**). Due to the seasonal nature of flow, neither hydric soil nor riparian vegetation are well developed at these locations. Rodeo Creek drains the majority of the Project area but is intermittent, flowing primarily during spring months (March through June). No riparian vegetation is found along its banks, and it has been described as “basically a ditch” (Lamp 2001).

The nearest identified riparian areas are along the upper reaches of Lynn and Simon creeks. Riparian/wetland vegetation along these streams total 31 acres, including 2 acres of herbaceous stream bank vegetation and 29 acres of wet meadow (BLM 2000a).

Approximately 2,150 acres of wetlands and riparian zones associated with streams, seeps, and springs are located in the vicinity of the Leeville Project in the southern end of the Tuscarora Range (BLM 2000a). The wetlands/riparian zones are further subdivided by type as follows: streambar, 362 acres; herbaceous streambar, 590 acres; wet meadow, 733 acres; salix streambar, 58 acres; salix-mesic meadow, 27 acres; mesic meadow, 161 acres; salexi-wet meadow, 217 acres; and salix-wet meadow, 1 acre. These riparian acres are located in the geographic area encompassed by **Figure 3-10**. The *Water Quantity and Quality* section of this chapter contains a detailed description of the location of springs, seeps, and perennial flowing segments of streams in the Project area.

Current discharge to the TS Ranch Reservoir and infiltration to groundwater have resulted in formation of three large spring areas (Sand Dune, Green, and Knob springs) south of the reservoir. Additional riparian areas within the general study area include those associated with Simon and Lynn creeks. Riparian areas associated with these streams are generally sporadic and contain vegetation types such as grassy wet meadow, and streamside sedge/herbaceous (BLM 2000a).

FISHERIES AND AQUATIC RESOURCES

The fishery resources study area for the Leeville Project includes the Boulder and Maggie creek drainages and portions of the Humboldt River (**Figure 3-5**). Fish species collected in the study area include several species of trout, including Lahontan cutthroat trout (LCT), minnows, suckers, and bass (**Table 3-23**). Lahontan cutthroat trout is federally listed as threatened and is the Nevada State fish (Coffin 1981). Since the late 1800's, other fish species (e.g., other trout and warm water fish species) have been planted in creeks in the study area. Due to exotic introductions and decline in stream habitat conditions, Lahontan cutthroat trout populations have declined. Lahontan cutthroat trout have also hybridized with rainbow trout in some areas of the Humboldt River Basin. Lahontan cutthroat trout is further discussed in the *Threatened, Endangered, Candidate, and Sensitive Species* section in this chapter.

Fishery resource surveys were conducted in Boulder, Brush, and Rodeo creeks in 1988 and 1990. Lahontan speckled dace was the only fish present (JBR 1988, 1990b). This fish is able to tolerate poor habitat quality present in these streams. Boulder, Bell, Brush, and Rodeo creeks
are small, intermittent streams, with some perennial flow in upper reaches. Streams in the Boulder and Maggie creek drainages have been impacted by livestock grazing and fires during 2001. Limiting factors for fish in the Boulder Creek drainage include lack of water, high water temperatures during spring and summer, lack of shade and cover, and lack of suitable pool habitat (A.A. Rich and Associates 1999). Brush Creek has been dry since 1994 (Adrian Brown Consultants 1997).

The Maggie Creek Watershed Restoration Project was implemented in 1993 by Newmont, BLM, and the Elko Land and Livestock Company, as mitigation for Newmont's South Operations Area Project. As a result, aquatic habitat parameters such as riparian zone width, riparian condition class (percent optimum growth), stream width/depth ratio, bank overhang distance, woody vegetation overhang distance, and percent stream width with quality pools have improved (BLM 1997b). Specific streams with improved conditions include Maggie, Coyote, Little Jack, and Simon creeks (BLM 2000c).

Fish sampling was conducted in 1997 in Lynn, Maggie, Beaver, Little Beaver, Spring, Little Jack, and Coyote creeks within the Maggie Creek sub-basin. Fish species documented included speckled dace, Lahontan redside, Tahoe sucker, and Lahontan cutthroat trout (AATA International 1997). Speckled dace was the most abundant species in the middle and lower reaches of all streams. Lahontan cutthroat trout were dominant in the upper reaches of Beaver, Little Jack, and Coyote creeks (BLM 2000c).

Macro-invertebrate communities in streams within the Project area are generally low in diversity, with species composition reflecting degraded con-ditions in the streams (e.g., high temperature). Primary factors limiting macro-invertebrate diversity and abundance in the area include intermittent stream flow, sediment loading, high temperature, and lack of shade.

TABLE 3-23
Fish Species Collected Within the Study Area

Salmonidae (Trout and Salmon)	
Lahontan Cutthroat Trout[1]	*Salmo clarki henshawi*
Brook Trout[1]	*Salvelinus fontinalis*
Rainbow Trout[1]	*Oncorhynchus mykiss*
Brown Trout[1]	*Salmo trutta*
Cyprinidae (Minnows)	
Lahontan Reside Shiner[1,2]	*Richardsonius balteatus*
Lahontan Speckled Dace[1,2]	*Rhinichthys osculus* robustus
Lahontan Tui Chub[2]	*Gila bicolor obesa*
Common Carp[2]	*Cyprinus carpio*
Catostomidae (Suckers)	
Mountain Sucker[1,2]	*Catostomus platyrhynchus*
Ictaluridae (Catfish)	
Channel Catfish[2]	*Ictalurus punctatus*
Centrarchidae (Bass)	
Smallmouth Bass[2]	*Micropterus dolomieui*

[1] Creeks
[2] Humboldt River
Source: JBR Consultants 1992a; AATA International, Inc. 1997, 1998; BIO/WEST 1994.

TERRESTRIAL WILDLIFE

The study area for terrestrial wildlife resources for the Leeville Project includes the Tuscarora Mountains, Little Boulder Basin, and Sheep Creek Range. The Leeville Project is the area that would be directly impacted by mine development, and the pipeline/canal water conveyance system. Descriptions of terrestrial wildlife and range conditions have been developed from site visits, general literature sources, Nevada Division of Wildlife (NDOW) reports, BLM reports, JBR Consultants baseline data reports, and Cedar Creek Associates' data summary reports.

Other sources of information on wildlife found in the Elko area include Christensen 1970 (Chukar Partridge), Clark 1987 (mammals), NDOW 1992 (raptors), Rawlings and Neel 1989 (Humboldt River Wildlife), and Zevaloff 1988 (Western mammals).

MULE DEER

The Project Area is located within NDOW Management Area Six. Mule deer are the most abundant big game species in the management area. The mule deer population in Area Six experienced a decrease of 50 to 60 percent during the winter of 1992-93 due to severe winter conditions and poor condition of winter habitat. Over the past 6 years, the population has experienced significant growth (up to 70 percent) as a result of mild winters and good recruitment. Forage conditions for mule deer in recent years have ranged from good to excellent in the area.

The Leeville Project is located in mule deer transitional range used during migration from summer range in the higher elevations of the northern Tuscarora Mountain Range to winter range in the lower elevations of the Tuscarora Range, Sheep Creek Range, and Boulder Valley (**Figure 3-15**). Timing and duration of the fall and spring migrations of mule deer are primarily dependent on severity of climatic conditions. Snow accumulations in the higher elevations of the Tuscarora Range initiate southern migration. When snow accumulations are light, mule deer tend to remain on transitional range for longer periods, taking advantage of the security and forage on available browse in shrub communities and riparian zones. In mild winters, it can be late December before mule deer reach their winter range. In harsher winters, when snow begins to accumulate earlier in the season, mule deer move more rapidly through transitional range to winter range. During harsh winters, more time is spent on winter ranges, some of which have been degraded by wildfire (BLM 1993a, 1996a).

Figure 3-15

blank

Some winter range in the Dunphy Hills, as well as transitional range in the Tuscarora Mountains, has been targeted for restoration by Newmont. Work-ing in conjunction with the TS Ranch, NDOW, and BLM, Newmont began reseeding 2,300 acres in the Dunphy Hills winter range improvement area in 1992. The areas seeded had been impacted by range fire in the 1960s and have since been dominated by cheatgrass. The 1992 seeding was the first of a three-phase program designed to rejuvenate native vegetation communities lost to range fires. The final phase of the program was completed in 1995. In addition, approximately 9,800 acres of mule deer winter range was seeded in 1996-1997 as a result of the Bob Flat Emergency Fire Rehabilitation and Mule Deer Mitigation Reseeding Project.

Mule deer use transitional areas for longer periods due to high quality browse generally available on this range. This improves the animals' physical condition prior to moving onto winter range. Late arrival on winter range also subjects limited forage species to less browsing, which reduces stress on mule deer populations related to quality and quantity limitations of the food supply (BLM 1996a).

Prior to 1987, mule deer reportedly migrated south along both the east and west flanks of the Tuscarora Mountains to their winter ranges (Gray 2001). Due to mining activities in the Carlin Trend and degradation of habitat by wildfire, mule deer on the west side of the Tuscarora Mountains have shifted their preferred migration route to the east flank of the Tuscarora Mountains at Simon Creek. At Welches Canyon, some mule deer migrate to the west side of the mountains enroute to the Dunphy Hills and Boulder Valley areas, while others continue to move south to Marys Mountain, Emigrant Pass, and Palisade Canyon areas. Some mule deer, migrating on the western slopes of the Tuscarora Mountains, advance west to Sheep Creek and Izzenhood winter ranges (BLM 1993b, 1993c; Gray 1997; Evans 1992).

PRONGHORN ANTELOPE

The Leeville Project is located at the southwestern edge of the Little Boulder Basin within an area designated as critical pronghorn antelope (pronghorn) summer range (**Figure 3-15**). The area surrounding much of the proposed mine development is relatively poor pronghorn habitat due to high relief. However, important pronghorn summer habitat occurs at lower elevations of the area where the proposed dewatering pipeline and canal is located. Up to 200 pronghorn have been recorded in the vicinity of the proposed canal (Gray 2001; Lamp 2001).

Pronghorn are typically associated with open grasslands, grasslands-brushlands, or bunch grass-sagebrush areas where overall shrub cover is less than 30 percent, shrub stature is less than 24 inches, and a good component of forbs exist. In summer, pronghorn graze on a number of plants including grass, various forbs, sagebrush, and bitterbrush. In winter they browse on many different plants but favor sagebrush.

Areas lacking a shrub component, areas of high topographic relief, or areas with large stands of tall sagebrush which restrict visibility, are poor pronghorn habitat (BLM 1993b; Evans 1992; Burt and Grossenheider 1976; and Whitaker 1988).

OTHER MAMMALS

The list of mammals compiled by BLM for the Elko District contains 76 species, including 5 shrews, 12 bats, 5 rabbits and hares, 33 rodents, 15 carnivores, and 6 ungulates. About 50 to 60 species of mammals could potentially inhabit the Leeville Project area. They include 2 to 3 shrews, 9 to 10 bats, 4 rabbits and/or hares, 22 to 27 rodents, 11 to 13 carnivores, and 2 ungulates (BLM 1993b, 1997c).

Of the species that occur in the Project area, a few (e.g. house mouse) are generally restricted to human-related habitats such as buildings. Four species (river otter, mink, beaver, and muskrat) are essentially aquatic. Although they are occasionally observed away from water, it is unlikely that they would be found within the Project area. Eight or nine species, including the vagrant shrew, montane vole, Nuttall's cottontail, and raccoon, are usually found in riparian or wetland habitats.

Most mammals present in the Project area are upland species, though they sometimes occur in forest, riparian, or wetland habitats. For example, the Merriam shrew, pygmy rabbit, several ground squirrels, and the sagebrush vole may be entirely restricted to sagebrush or grassland habitats, while the coyote, porcupine, mountain lion, and mule deer are found in a wide variety of habitats. Some bats roost in buildings, trees, mine adits, caves, or cracks and crevices in rocks in upland habitats even though they forage for insects in habitats near water (BLM 1993b).

UPLAND GAME BIRDS

Sage grouse, chukar, and Hungarian partridge are present year-round in the vicinity of the Leeville Project. Sage grouse are native to the area and are associated with sagebrush habitats in the rolling hills and benches along drainages. In spring, they congregate at breeding sites called leks, where males conduct displays to attract females. In summer, sage grouse occupy the foothills and higher elevations of the Tuscarora Range, using meadows and seeps along creeks for foraging and watering. During winter, sage grouse use low elevation sagebrush stands, which are usually large areas containing a mosaic of sagebrush species, heights, ages, and forage quality. Sagebrush stands located on south or west-facing slopes provide important habitat during severe winters. Further discussion of sage grouse can be found in the *Threatened, Endangered, Candidate, and Sensitive Species* section in this chapter.

Chukar is an Old World species introduced to North America. They are found on rugged slopes, in canyons, and associated drainages. Availability of water directly influences occurrence of chukar within these habitats. During summer, broods and adults feed extensively on succulent vegetation, seeds, and insects found in mesic habitats. Groups of 27 chukar have been documented along Brush and Bell creeks in the Little Boulder Basin (National Geographic Society 1987; BLM 1993b; JBR 1994).

The Hungarian or gray partridge is an introduced species associated with complexes of grassland, shrubland, grain fields, and water sources. Hungarian partridge are wide-spread but not abundant in the area. A small population exists in Little Boulder Basin on lower Rodeo Creek. These birds are not as water-dependent as chukar, or as riparian-dependent as sage grouse, although they probably visit mesic habitats to feed on insects, green vegetation, and consume water (BLM 1993b).

The mourning dove is a native migratory game bird found seasonally in and around the Project area. They use habitat in the area but are commonly found at lower elevations. Adults feed in open areas on seeds, which comprise 99 percent of their diet. Young feed on crop milk for the first three days and then on crop milk and seeds. By the time they are 6 to 8 days old the young feed entirely on seeds. Doves generally nest in tall shrubs and trees and tend to congregate near water sources. Large numbers of mourning doves have been observed along upper Maggie Creek and in the Little Jack and Indian creek drainages. Adult doves have also been sighted along portions of Boulder and Bell creeks foraging for food and water (BLM 1993b, 1996a; Ehrlich et al. 1988).

RAPTORS

Raptor species occupy a wide range of habitats including woodland, wetland, riparian, and desert. While some species restrict their activities, such as nesting and foraging, to one distinct habitat (e.g., sharp-shinned hawk), others range over broad areas of varying habitats (e.g., golden eagle). Some species nest and forage in the same habitat type while others nest in one type and forage in another. All habitats within the study area are used as foraging habitat by one or more raptor species. Riparian habitats are used by a greater variety of raptors than upland habitats because of the abundance, diversity, and density of prey species. However, upland habitats are the dominant type in the Project area and provide the majority of foraging habitat for raptors.

Primary nesting habitat for raptors within the study area includes cliffs (golden eagle, red-tailed hawk, ferruginous hawk, prairie falcon, American kestrel, great-horned owl), aspen and cottonwoods (red-tailed hawk, Swainson's hawk, American kestrel, northern goshawk, great horned owl), juniper (ferruginous hawk), and riparian (Swainson's hawk, northern harrier, great horned owl, long-eared owl). Other sites used by some raptors for nesting include utility poles, abandoned buildings, mine pit walls, stream banks, and marsh vegetation (BLM 1993b).

According to BLM's bird species list, there are currently 27 raptor species identified within the Elko District. They include 1 vulture, 2 eagles, 11 hawks, 4 falcons, and 9 owls. Raptor use of habitat within Little Boulder Basin is restricted to species that are adept at hunting in open country and nesting on the ground, rock outcrops, cliffs, or vertical stream banks. Baseline studies for Little Boulder Basin conducted by JBR from 1987 to 1993 documented 12 species of raptors in the basin. They include turkey vulture, sharp-shinned hawk, Cooper's hawk, red-tailed hawk, rough-legged hawk, ferruginous hawk, Swainson's hawk, golden eagle, bald eagle, northern harrier, prairie falcon, and American kestrel.

In 1992, JBR conducted an inventory of raptor nest sites within the Newmont Inventory Area. The Newmont Inventory Area encompassed approximately 166,400 acres between the Tuscarora Mountains and Independence Mountains north to the southern end of T37N and south to the southern end of T32N, which included Maggie Creek and Susie Creek. The northwestern edge of the Newmont Inventory Area boundary cuts through a portion of the Project area in Section 11, T36N R50E. The inventory did not cover areas west of the Project site. During this inventory, nests of seven raptor species, including red-tailed hawk, northern goshawk, great horned owl, American kestrel, golden eagle, ferruginous hawk, and northern harrier, were located within a 10-mile radius east of the Project area. The most common nesting species documented within the 10-mile area was the red-tailed hawk.

Other species found within the Newmont Inventory Area included Swainson's hawk, prairie falcon, and long-eared owl. Species suspected of nesting within the area include turkey vulture, sharp-shinned hawk, Cooper's hawk, short-eared owl, and burrowing owl. Northern goshawk, ferruginous hawk, and burrowing owl are BLM sensitive species (BLM 1993b, 1997c; JBR 1992a).

Northern goshawks generally inhabit mature, uneven-aged coniferous and mixed forest habitats, with relatively open understory, dominantly in mountainous areas. In Nevada, aspen groves provide preferred nesting habitat. Goshawks demonstrate high fidelity to specific nesting territories, but from year to year may use alternative nest sites within a territory. The Northern goshawk is a common nester in the Independence Mountains east of the Project, however habitat preferred by this species does not exist in the Project area (Cedar Creek Associates 1997; JBR 1992b).

MIGRATORY BIRDS

BLM lists 75 species of waterfowl and shorebirds found in the Elko District. Historically, migratory bird numbers were not high in the Little Boulder Basin, however, the incidence of use and number of birds have increased during the last decade. This increase was attributed to the TS Ranch Reservoir and mounding groundwater resulting in the formation and expansion of Green, Sand Dune, and Knob springs (**Figure 3-10**). Increased surface water availability and increased emergent and submergent vegetation in Boulder Valley have provided additional foraging, cover, resting, and breeding habitats for migratory bird species, particularly waterfowl and shorebirds. The number of waterfowl using these habitats within Boulder Valley fluctuates according to changing water levels. Some species may forage and nest in adjacent habitats, such as irrigated alfalfa fields or springs and seeps. Waterfowl use in the remainder of the study area is restricted to limited available surface water.

Due to the limited amount of water, the number of species potentially occurring in the Project area would be much less. Waterfowl and shorebirds recorded in the Little Boulder Basin include eared grebe, white-faced ibis, Canada goose, mallard, gadwall, pintail, green-winged teal, blue-winged teal, cinnamon teal, American widgeon, northern shoveler, ruddy duck, redhead, ring-necked duck, lesser scaup, American coot, American avocet, black-necked stilt, killdeer, greater yellowlegs, and Wilson's phalarope (BLM 2000b; JBR 1993, 1994).

NONGAME BIRDS

The BLM has identified 246 species of birds in the Elko District. In the Little Boulder Basin, 66 non-game species not previously discussed in this section have been documented during baseline studies (JBR 1988, 1990b, 1990c, 1992c). Due to habitat limitations, many of these birds are not expected to occur in the Project area. Most birds frequent wetland and riparian habitats. Some species might nest in upland habitats found in the Project area and forage in riparian habitats; others might nest in riparian habitats and forage in up-land habitats. Still others might nest and forage in both. Most of the songbirds that reside in the area during the summer months are neotropical mig-rants, which winter in Central and South America.

A few species such as rock wren, northern mockingbird, pinyon jay, loggerhead shrike, and house finch are present in the area year-round.

REPTILES AND AMPHIBIANS

Twenty-eight species of reptiles and amphibians have been identified in the Elko District. The diversity of species in the area is likely limited by the cool, dry climate of northeastern Nevada. During baseline studies conducted by JBR from 1988 to 1993, nine amphibian and reptile species were documented in the Little Boulder Basin: Great Basin spadefoot toad, Pacific treefrog, desert horned lizard, long-nose leopard lizard, northern sagebrush lizard, Great Basin western fence lizard, western yellow-bellied racer, red coachwhip, and Great Basin gopher snake. Bullfrogs were documented along the Humboldt River, and the Great Basin whip-tailed lizard and Great Basin rattlesnake have been documented in the Boulder and Bell creek drainages.

Amphibians found in the Elko District are depen-dent on water sources, primarily during the breed-ing and juvenile stages. Two species docu-mented in the Little Boulder Basin (the Great Basin spadefoot toad and the Pacific treefrog), both require a water source during breeding and the tadpole stage. Reptiles generally do not require a water source; however, many species forage extensively in mesic and wetland habitats. Reptiles and amphibians documented in Little Boulder Basin were considered uncommon or rare and probably represented a small portion of the potential prey base in the Project area (BLM 1992, 1997d; JBR 1994; Cedar Creek Associates 1997).

THREATENED, ENDANGERED, CANDIDATE, AND SENSITIVE SPECIES

Threatened, endangered, and candidate species are those species for which state or federal agencies afford additional protection by law, regulation, or policy. Included are federally listed species protected by the Endangered Species Act (ESA); species proposed for federal listing, and federal candidate species, as identified by the United States Fish and Wildlife Service (USFWS); and species designated as state-sensitive by BLM (BLM 2000c). The BLM has also incorporated part of the Nevada State Protected Animal List into its sensitive species list. These species are afforded the same level of protection as candidate species if present on public land administered by BLM (BLM 2000c). The study area for threatened, endangered, candidate and sensitive species is the same as that for terrestrial wildlife.

THREATENED AND ENDANGERED

Bald eagle (threatened, proposed for delisting), and Lahontan cutthroat trout (threatened) occur in or near the study area. LCT do not occupy habitat in the immediate Project area, but are present in the Maggie Creek drainage to the east, and the Rock Creek drainage north of the Project area (**Figure 3-5**).

Bald Eagle

Bald eagles are periodic seasonal migrants and winter residents in Nevada. A few bald eagles occasionally may be present near the Project area as transient visitors and may winter near bodies of water that remain free or partially free of ice (e.g., Humboldt River and Maggie Creek). Bald eagles usually winter near bodies of water because fish and waterfowl are common prey and riparian areas often have trees which are used as hunting perches or for roosting. In the absence of waterfowl and fish, bald eagles eat carrion or prey upon small mammals such as black-tailed jackrabbits (Ryser 1985). Wintering bald eagles are present along the Humboldt River and have been observed in Independence Valley and along the North Fork Humboldt River (Cedar Creek Associates 1997). No nests or communal roosts are known to occur in or near the Project area.

Lahontan Cutthroat Trout

Lahontan cutthroat trout have historically occupied streams including the mainstem of the Humboldt River. Habitat degradation, water development projects, and introduction of non-native trout that hybridize and compete with LCT have eliminated the species over much of its former range (USFWS 1995).

Within the Humboldt River Basin, LCT presently occur in 83 to 93 streams, in approximately 14 percent of its historical range within the basin (USFWS 1995). Most existing populations are found in eight subbasins, including Marys River, Maggie Creek, Rock Creek, Little Humboldt River, Reese River, and the North, South, and East forks of the Humboldt.

Populations of LCT in the Maggie Creek subbasin declined markedly during the early 1900s. LCT are currently present in upper Maggie, Little Jack, Toro Canyon, Coyote, Beaver, Little Beaver (BLM 1993b), Jack (AATA 1997), Indian, and Lone Mountain (Valdez and Trammel 2000) creeks. Populations are in an upward trend due to improving habitat conditions. Habitat improvement is largely due to implementation of recent habitat enhancement efforts, including measures enacted by Newmont through the Maggie Creek Watershed Restoration Project (MCWRP), implemented in 1993. Streams once characterized by eroding streambanks and wide, shallow channel profiles now support healthy functioning riparian zones and stable, well vegetated streambanks.

LCT are relatively abundant in Little Beaver, Toro Canyon, and upper Coyote Creeks. Reproducing populations have been documented in Beaver, Little Jack, lower Jack, Toro Canyon, and Coyote creeks (AATA 1997; NDOW 2000). Due to possible fish migration barriers, including some perched culverts on the Maggie Creek Road, and lack of perennial streamflow in the lower reaches of some tributaries, it is believed that each LCT population in the subbasin is genetically isolated (AATA 1997). Migratory pathways may be available during high water flow years.

Although habitat conditions in the majority of the Beaver Creek drainage improved in recent years as a result of changes in livestock grazing, a wildfire in August of 2001 caused damage to riparian zones in the drainage. Almost the entire watershed and all of the aspen/willow community along Beaver Creek and its tributaries was burned. Although limited numbers of LCT survived the fire, the long-term effects of the fire are unknown at this time.

Populations of LCT in the Rock Creek subbasin have been documented in Willow Creek Reservoir, and in Frazer, Willow, Toe Jam, Nelson, and Rock creeks. Toe Jam and upper Rock Creek have the highest quality occupied habitat in terms of linear miles. Frazer is the most productive creek in the subbasin. There are an estimated 25 miles of potential LCT habitat in the subbasin (BLM 2000a).

CANDIDATE AND SENSITIVE SPECIES

Habitat exists within or near the Project area for the following plant and animal species considered by BLM as special status: Preble's shrew, spotted bat, pale Townsend's big-eared bat, Pacific Townsend's big-eared bat, long-legged myotis, western long-eared myotis, western small-footed myotis, fringed myotis, golden eagle, northern goshawk, Swainson's hawk, ferruginous hawk, burrowing owl, sage grouse, Lewis buckwheat, Columbia spotted frog, Nevada viceroy, California floater, and spring snails. Other special status species for which suitable habitat is not present are not discussed.

Preble's Shrew

Preble's shrew has been documented in northern Elko County (Ports and George 1990) and Washoe County (Hoffman and Fisher 1978). This shrew is found in a variety of habitats, including arid grassland and shrubland, alpine tundra, forest edges, and wetland habitat containing emergent and woody species. Prebble's shrew has not been documented in the immediate vicinity of the Leeville Project, but suitable habitat is present (BLM 2000c).

.

Spotted Bat

This species has not been reported in northeastern Nevada, but is typically found in rough desert terrain with limestone or sandstone cliffs (Zevaloff 1988). The spotted bat favors cliffs or rocks near perennial watercourses (Clark 1987). Its range extends over most of the western United States and includes all of Nevada.

Townsend's Big-Eared Bat

Two subspecies, Pale and Pacific of Townsend's big-eared bats, could inhabit northcentral Nevada (BLM 2000c). It is not known which subspecies has been reported in the vicinity of the Project area. Townsend's big-eared bats use a variety of habitats, including shrub-grassland present in the Project area. Townsend's big-eared bats were observed near the Project area in abandoned mine shafts in the upper Lynn Creek drainage. Two males in breeding condition were captured in mine shafts, and bats suspected to be big-eared bats were observed flying over springs and ponds near an abandoned mine shaft (Butts 1992). A subsequent survey in accessible mine adits revealed two adult males roosting separately in two adits near Lynn Creek in 1993 (Cedar Creek Associates 1997). This species has not been documented in the Project area.

Long-Legged Myotis

The long-legged myotis is a colonial bat species which roosts in buildings, caves, abandoned adits, trees, and rocky crevices. The species is known to hibernate in abandoned adits and caves (Zevaloff 1988). Long-legged myotis have been observed in the Independence Mountains, approximately 20 miles northeast of the Leeville Project. They have not been documented in the Project area.

Western Long-Eared Myotis

The western long-eared myotis roosts individually or in small groups, in trees, crevices, and occasionally in mines and caves. The species has been observed in the Independence Mountains and near Soap Creek, about 20 miles southeast of the Project area (Butts 1992).

Western Small-Footed Myotis

The western small-footed myotis inhabits canyons and rocky areas of the western United States. They roost and raise young in crevices in cliffs, and talus slopes. Summer roosts are variable and include buildings, mines, tree bark, and rock crevices (Cedar Creek Associates 1997). Rock outcrops in the Project area may provide suitable habitat for this species. This species was documented in an adit at the nearby Lantern Project in 1996.

Fringed Myotis

Fringed myotis are usually associated with desert, arid grassland, and woodland habitat at elevations between 3,500 and 6,500 feet AMSL in the western United States (Barbour and Davis 1969). It uses abandoned mines and caves as hibernacula. Fringed myotis could occur in the Project area based on habitat affinities and results of previous field studies, though none have been documented (BLM 2000c).

Golden Eagle

The golden eagle is found in a variety of open, often relatively dry habitat throughout the western United States. In Nevada, the golden eagle often nests on cliffs overlooking sagebrush flats, pinon-juniper woodland, salt desert shrub, and other habitat supporting an adequate prey base (Herron et al. 1985). Primary prey include rabbits, prairie dogs, ground squirrels, marmots, woodrats, grouse, and some carrion (DeGraaf et al. 1991).

Golden eagles are year-round residents of north-central Nevada. A large number of foraging and roosting golden eagles have been documented throughout the region, including mountains and foothills of the Tuscarora Range (BLM 2000c). An active nest site was recorded along Boulder Creek in 1990 (JBR 1992b). Potential foraging habitat is present within the Project area.

Osprey

The osprey is primarily a spring and fall migrant in Nevada. Ospreys nest in trees or dead snags, usually within a mile of water, and will readily use man-made structures when available (e.g. utility poles, steel transmission line towers, chimneys). In Nevada, one pair of nesting ospreys was recorded at Lake Tahoe in the 1970's (BLM 2000c). The primary diet of the osprey is fish, usually caught near the surface while in flight. Other minor food sources include frogs, snakes, ducks, and small mammals.

Breeding of ospreys is unlikely in the vicinity of the Carlin Trend, though occasional migrants may roost or forage within the cumulative effects area. One osprey was recorded along the Humboldt River near Herrin Slough in Humboldt County (BLM 2000c). Ospreys have also been recorded in the Dunphy area (Gray 2001).

Northern Goshawk

The northern goshawk is a year-around resident of northern Nevada, occupying higher elevation woodland, primarily aspen and conifer stands, in summer, and wintering in lower foothills and valleys (Herron et al. 1985). Primary prey includes birds, small mammals, and insects (DeGraaf et al. 1991). Potential wintering habitat is found in parts of the Tuscarora Range, and northern goshawks may conceivably forage within the Project area.

Swainson's Hawk

The Swainson's hawk is a summer resident of north-central Nevada, and is one of the least abundant raptors in the region (BLM 2000c). In Nevada, the majority of nesting territories have been located in agricultural valleys ranging in elevation between 4,000 and 6,500 feet. Nests have been found in buffaloberry, serviceberry, sagebrush, willow, and aspen, though most documented nests in Nevada have been in Cottonwood or elm trees (Herron et al. 1985). Several nesting pairs have been documented in valleys near the Tuscarora Range (BLM 2000c). Forage consists of a variety of small mammals, birds, reptiles, and amphibians (DeGraaf et al. 1991). Swainson's hawks have not been documented on the Project area, but foraging habitat is found along some nearby drainages at lower elevations.

Ferruginous Hawk

The ferruginous hawk inhabits grassland, shrub-land, and steppe-deserts of the western United States and is considered fairly common through-out northeastern Nevada. In Nevada, preferred nesting habitat is scattered juniper in the edges between pinyon-juniper and desert shrub com-munities where they nest in trees, on buttes, and on the ground. Ferruginous hawks forage in desert shrub, open prairie, brushy open country, grassland, and badland communities. They feed on small mammals, especially ground squirrels and jackrabbits, but also eat snakes, lizards, and insects. During baseline surveys, performed by JBR from 1987 to 1993, ferruginous hawks were sighted twice, once in Boulder Valley and once near Bell Creek. During the 1992 raptor nest inventory (JBR 1993), four ferruginous hawk nests were found in the Newmont Inventory Area and six birds were sighted. Nesting habitat (e.g., juniper trees) for this species is not present in the Project area (Cedar Creek Associates 1997; JBR 1992a, 1994).

Sage Grouse

Sage grouse are present throughout the year in sagebrush habitat in the foothills of the Tuscarora Range, including the Project area. Sage grouse winter in sagebrush habitat and feed primarily on sagebrush foliage. During spring and summer, they use meadows, springs, and seeps for foraging and water. Sage grouse exhibit courtship display on traditional strutting grounds (leks) in March through early May. Broods hatch in June and feed on insects and forbs.

Field surveys indicate sage grouse populations vary from year to year. Five leks were observed in the South Operations Area and two in the North Operations Area (one in the northern part of Little Boulder Basin and one in the North Fork Bell Creek). No leks are known to occur in the Project area, although sage grouse are present in low numbers.

Burrowing Owl

During the summer months, western burrowing owls inhabit open grassland areas throughout the western United States. Breeding by burrowing owls is strongly dependent on presence of burrows, usually constructed by ground squirrels, prairie dogs, or badgers. Prime burrowing owl habitat is open country with short vegetation and abundant mammal burrows. Some burrowing owl habitat exists in the Project area, however, no burrowing owls were documented during baseline studies (Cedar Creek Associates 1997).

Lewis Buckwheat

Lewis buckwheat is a low-growing, matted, or mounded perennial forb that is restricted to dry, open, relatively barren, and undisturbed ridgeline crests and knolls underlain by silicaceous carbonate and limestone rock (Morefield 1996). Known habitat typically includes sparse to moderate stands of low sagebrush, green rabbit-brush, Indian ricegrass, and squirreltail. It is endemic to the Tuscarora, Bull Run, and Independence Mountains, and the Jarbidge Mountains complex (Morefield 1996). Thirty-three populations in 10 general localities have been documented. Three populations are located south of the Project area in the Tuscarora Mountains, north of Emigrant Pass and adjacent Marys Mountain, at approximately 6,950 to 8,337 feet (Morefield 1996). None have been documented in the Project area, though suitable habitat exists.

Nevada Viceroy

The Nevada viceroy is associated with willow stands in riparian habitat found in valley floors below 6000 feet. Its current distribution includes northcentral Nevada, where it is rare, though it has been reported from several locales in the Carlin area. Potentially suitable habitat was iden-tified along Little Jack, lower Suzie, Maggie, Coyote, Boulder, and Bell creeks, though no Nevada viceroys have been documented in these areas (BLM 2000c). They may, but are unlikely to occur in willow habitat at lower elevations near the Project area.

California Floater

The California floater is a freshwater mussel that occurs primarily in small, permanent streams with pool or run habitats and substrates consisting of silt, gravel, and sand (McGuire 1995). California floaters have been documented at two locations on Maggie Creek, east of the Leeville Project area. One site is immediately north of the confluence of Maggie Creek and the East Fork of Cottonwood Creek, and the other about midway between the confluences of Maggie Creek with Cottonwood Creek and with Jack Creek/Little Jack Creek (BLM 2000c). They have also been documented in lower Rock Creek Canyon, west of the Leeville Project area.

Springsnails

Springsnails are tiny mollusks found in some perennial springs and seeps in the Carlin Trend. Springsnails were documented at three of 65 sites surveyed in 1992 area and at seven of 41 springs and seeps surveyed in 1995 and 1996 in the area (BLM 2000b). Sites include: Willy Billy Spring (unnamed tributary of Buck Rake Jack Creek), Rattlesnake Spring (flowing into Humboldt River), Warm Spring (adjacent to Humboldt River near Carlin), and six springs in upper Antelope Creek (BLM 2000a). Springsnails have not been found in the Maggie Creek subbasin. Habitat in springs supporting springsnails have stable, moderately high discharges; gravel, cobble, or boulder substrates; and dense aquatic vegetation (McGuire 1995).

Columbia Spotted Frog

Columbia spotted frogs occur in wetland habitats ranging from subalpine forests to lower elevation grassland and shrubland. They are generally associated with permanent water bodies with emergent vegetation, though they may be found in many habitats including shrubland and grassland. Columbia spotted frogs have been documented in and around permanent water in middle Maggie Creek, lower Coyote Creek, and lower Little Jack Creek. They were not observed during surveys conducted on Antelope, Rock, and Boulder creeks in 1995 (BLM 2000b).

GRAZING MANAGEMENT

Grazing allotments are areas of public and unfenced private land used by permittees for livestock grazing. Grazing within these allotments is permitted and administered by BLM.

The T Lazy S Allotment (**Figure 3-16**) is permitted to the Elko Land and Livestock Company, a subsidiary of Newmont. Due to extensive mining operations within its confines, past adjustments have occurred to the T Lazy S permit to account for withdrawn land associated with Barrick's Betze/Post Mine, Newmont's South Operations Area, and all of Newmont's mining operations collectively referred to as the North Operations Area (BLM 1995a). Based on these past adjust-ments, the current permitted use is 11,999 animal unit months (BLM 1998a). An animal unit month (AUM) is the amount of forage required to sustain one cow and calf for one month. Total permitted grazing use for the allotment, including active use and suspended non-use (due to mining activity and short-term fire rehabilitation closures), is 14,209 AUMs.

The T Lazy S Allotment is operated as a commercial cow/calf operation. Depending on climatic and forage conditions, and the status of several ongoing habitat improvement projects, the BLM grazing permit has evolved in recent years to allow approximately 2,300 to 2,800 head, managed in two herds, to graze the allotment during the interval of mid-February through November (Nyrehn 1998). The type and location of existing range improvements located within the allotment are summarized in **Table 3-24.**

Figure 3-16

blank

TABLE 3-24
T Lazy S Allotment Range Improvement Permits Near Leeville Project

Permit No.	Project Name	Location	Notes / Comments
0566	Pond # 4	T34N R50E Sec 22	Stockwater reservoir
0568	Pond # 10	T34N R50E Sec 2	Stockwater reservoir
0572	Pond # 14	T35N R51E Sec 30	Stockwater reservoir
0596	Boulder-Bell-Haskell Creeks Fence	T33&37N R48&51E	Pasture fence.
0734	Hot Water Well (or TS Well)	T34N R50E Sec 10	Well with storage tank and trough
1070	Boulder Creek Seeding	T35-36N R49-50E	
1072	Boulder Aerial Seeding	T35N R50E	1964-1965 Fire Rehabilitation Seeding (6840 acres).
1106	Boulder Creek Fire Fences	T34-35N R50-51E	Fences constructed around Welches Creek; Coyote and Antelope seedings.
1107	Boulder Creek Fire Fences	T35N R50-51E	Fence constructed in Boulder Creek complex to protect fire rehabilitation seedings.
5042	Sheep Creek Drift Fence	T35N R49E Sec 12	Pasture fence.
5132	Rodeo Creek Fence	T36N R49-50E Sec 1, 2, 3, 6	Pasture fence.
5925	North Native Pasture Fence	T36N R50-51E	Pasture fence between Upper Northern Native and Lower Northern Native Pastures.

Source: Compiled by RCI from BLM permit / allotment files and BLM (1993c).

Two habitat improvement projects are now underway or have been completed within the T Lazy S Allotment. The Maggie Creek Watershed Restoration Project involved temporary closure of nine pastures to grazing until defined riparian habitat conditions are achieved. Prescripitive livestock grazing has resumed in all nine pastures. A controlled grazing plan, designed to improve riparian habitat conditions and watershed functions, has been implemented in two additional pastures (Nyrehn 2002).

A second habitat improvement project is the Bob Flat Emergency Fire Rehabilitation and Mule Deer Mitigation Reseeding. This project involved a cooperative effort by Newmont, NDOW, BLM and the Elko Land and Livestock to seed approximately 9,800 acres in the area of Bob Flat for wildfire rehabilitation and mule deer habitat enhancement (Nyrehn 1998). An important component of this project included a combination of livestock exclusion and controlled spring grazing designed to promote seedling establish-ment. Following successful establishment of the seeding (as monitored in 2000), livestock in this seeded area are currently controlled by pasture rotation, stockwater availability and active herding practices. Carrying capacity adjustments associated with the Maggie Creek Watershed Restoration Project are accounted for in the active grazing preference referenced above.

RECREATION AND WILDERNESS

The study area for Recreation and Wilderness is shown on **Figure 3-17** and consists of the BLM Elko District (which includes all of Elko County and northern portions of Eureka and Lander counties) and the eastern portion of Humboldt County. The Elko District extends over 12 million acres, about one-sixth of Nevada's total area. BLM administers 7.4 million acres of public land in the District that consist primarily of high desert and mountainous areas. Humboldt County is located in the BLM Winnemucca District and consists of 6.2 million acres, 5 million of which are publicly owned.

RECREATION

Outdoor recreational areas and facilities in the study area include those managed by BLM, Nevada Division of State Parks (NDSP), United States Forest Service (USFS), United States Fish and Wildlife Service (USFWS), Bureau of Indian Affairs (BIA), and private operators (**Figure 3-17**).

Public land within these areas provide diverse recreational activities, including fishing, sightseeing, hunting, cross-country skiing, horseback riding, white water rafting, photography, rockhounding, and off-highway vehicle use (BLM 1985, 1996b). The BLM does not maintain current recreational use data for public land in the Winnemucca District; however, recreational use in this area is assumed to be limited due to low population levels, difficult access to public land caused by the checkerboard pattern of public and private land boundaries, and lack of improved roads in the region (BLM 1996b).

BLM has designated six Special Recreation Management Areas (SRMAs) in the Elko District. SRMAs are areas warranting intensified manage-ment. The nearest SRMA to the Leeville Project is South Fork Canyon, located approximately 30 miles southeast of the Project area. South Fork Canyon encompasses 3,360 acres and has no developed facilities. The Zunino/Jiggs Reservoir SRMA is approximately 55 miles southeast of the Project area and has a restroom, picnic tables, barbecues, and campground. The Wilson Reser-voir SRMA is located 55 miles north of the Leeville Project area. Facilities include a boat ramp, restrooms, campground, and drinking water. Wild Horse SRMA, approximately 55 miles northeast of the Leeville Project area, has a BLM campground. A campground and boat ramp are located on BIA administered land within the SRMA boundaries. In addition, the Wild Horse State Recreation Area is located within the SRMA boun-daries. The South Fork Owyhee River SRMA is located 60 miles north of the Project and contains a narrow corridor along the river which is eligible for Wild and Scenic River designation. Salmon Falls Creek SRMA, is over 100 miles from the Project area near the town of Jackpot, Nevada.

There are no BLM-designated SRMAs in the portion of the study area located in eastern Humboldt County. Water Canyon, however, is a secluded mountainous area located along Water Canyon Creek in the Sonoma Range about 2 miles south of Winnemucca. The BLM acquired approximately 2,000 acres at Water Canyon which is being developed into a recreational area for picnicking, mountain biking, hiking, hunting, and wildlife viewing (Moritz 1998).

The BLM Back Country Byways Program identifies historical and scenic routes on public land. The Byways Program is designed to encourage use of existing back roads through greater public awareness. In the northeast corner of the Elko District, the California Trail Back Country Byway provides over 80 miles of scenic travel paralleling the original California Trail. The trail was a major route used by pioneers traveling from the Midwest to California and Oregon.

The Carlin Canyon Historical Wayside includes interpretative signs describing the geology and history of the area, parking spaces, and benches.

The United States Forest Service has three ranger districts in Elko County: Ruby Mountains, Mountain City, and Jarbidge. Santa Rosa Ranger District is located in Humboldt County. Of the three districts in Elko County, Ruby Mountains Ranger District experiences the heaviest recreation use. Located within 20 miles of Elko and Interstate 80, the Ruby Mountains Ranger District has 121 campsites in four campgrounds, two picnic areas, and two wilderness areas. The Lamoille Canyon Scenic Byway provides 12 miles of paved access in the Ruby Mountains with three pullouts and interpretive signs. At the end of the scenic byway, a trailhead provides access to the 40-mile-long Ruby Crest National Recreation Trail.

The Mountain City Ranger District has three campgrounds. The Jarbidge Ranger District has two campgrounds and one wilderness area. Both districts experience heavy use on weekends.

The Lye Creek and Hinkey Summit campgrounds are located in the Santa Rosa Ranger District approximately 75 miles from the Leeville Project. The facilities at Lye Creek include group camping, running water, and areas for picnicking. The Hinkey Summit campground has no developed facilities.

Willow Creek and Willow Creek Pond, located in western Lander County approximately 65 miles southwest of the Leeville Project, receive a large amount of recreation use. The creek is managed under the wild fishery designation of the Nevada Coldwater Fishery Program Management Con-cepts (NDOW 1988 *in* BLM 1998b). The pond is stocked by NDOW and managed as a catch and release fishery.

The Willow Creek Reservoir is located in Elko County approximately 18 miles north of the Leeville Project. Willow Creek Reservoir is owned by Barrick but is open to the public. NDOW manages the reservoir as a warm water fishery and periodically stocks it with crappie and channel catfish. The reservoir is also known to contain Lahontan Cutthroat Trout

Figure 3-17

blank

(Haskins1998). Camping is allowed at the reservoir, however there are no developed facilities.

The South Fork State Recreation Area (SRA) is located 35 miles southeast of the Leeville Project area adjacent to the BLM's South Fork Canyon SRMA. Facilities at the South Fork Reservoir SRA include a boat ramp, campground, and administrative facility. The Wild Horse SRA is located approximately 55 miles northeast of the Project area. The Wild Horse SRA encompasses 80 acres situated on the northeast shore of the Wild Horse Reservoir just off Nevada Highway 225. Amenities at the Wild Horse SRA include a campground and restrooms. Although there is no boat launch, there is vehicle access to the lake. According to the Nevada Division of State Parks, a boat launch may be constructed in the near future (NDSP undated brochure).

The Rye Patch SRA is a 22-mile long reservoir located on the Humboldt River approximately 125 miles west-southwest of the Leeville Project area. Recreation facilities at the Rye Patch Reservoir include three picnic areas, two developed campgrounds and numerous undeveloped campsites, a sanitary dump station, a boat ramp, and dock. The primary recreation activities are fishing, swimming, boating, water-skiing, camping, and picnicking. According to the Nevada State Parks Visitation Summary (prepared for calendar year 1997), there were 82,611 visitors at Rye Patch in 1997.

The Chimney Creek Reservoir is operated by Humboldt County. The reservoir contains over 2,000 surface acres and is located approximately 60 miles northwest of the Project site. Developed facilities at this site include a picnic table, pit toilet, and a boat ramp. Camping is allowed, however there is no running water.

The communities of Carlin and Elko (including Spring Creek) have a number of recreational facilities. Carlin has an archery range, three baseball fields, a park and playground area, a moto-cross track, a tennis court, and a volleyball court. Elko has numerous baseball fields, a BMX track, one bowling alley, fairgrounds, five gyms, two golf courses (one of which is under county jurisdiction), an indoor horse arena, moto-cross track, movie theaters, five parks, rifle and pistol range, three soccer complexes, six tennis courts, trap and skeet range, and a swimming pool (Sierra Pacific Power Company 1994). Snobowl Ski and Winter Recreational Area is located 6 miles north of Elko and provides opportunity for alpine and cross-county skiing, sledding, tubing, and snowmobiling. According to the Preliminary Draft Parks, Recreation, Open Space Plan, additional acreage within the city limits has been set aside that will meet community demands for parks, open space, and recreational facilities beyond 2010 (City of Elko 1998).

The Nevada Department of Conservation and Natural Resources (NDCNR) published the Statewide Comprehensive Outdoor Recreation Plan (SCORP) in 1987 and revised it in 1992. Comments received from the public indicated that primary recreation concerns for Nevadans included funding for maintenance and development of outdoor recreation facilities; protection and allocation of water resources; and access to natural, cultural, or historical resources in the state.

WILDERNESS

There are 10 Wilderness Study Areas (WSAs) in the Elko District **(Figure 3-17)**, seven of which all or portions of have been recommended for wilderness designation. The Little Humboldt River WSA and Red Spring WSA, approximately 25 miles northwest and 25 miles southeast (respectively) of the Leeville Project, are the closest WSAs, although Red Spring WSA is not recommended for further consideration as a wilderness area. The upper drainage basin of the South Fork of the Little Humboldt River is located in the Little Humboldt River WSA. This WSA offers a wide variety of recreational opportunities, including fishing, hiking, camping, hunting, rock climbing, and wildlife study. Portions of the Little Humboldt and Bullhead Wild Horse Herd Areas are located within this WSA, providing for wild horse viewing and photographing. The BLM has recommended 29,775 acres of the Little Humboldt River WSA as suitable for wilderness and 12,438 acres as unsuitable for wilderness (BLM 1987).

The remaining WSAs recommended for wilderness designation are the Badlands, Goshute Peak, Owyhee Canyon, Rough Hills, South Fork Owyhee River, and South Pequop.

Cedar Ridge, Bluebell, and the Red Spring WSAs were not recommended for wilderness designation (BLM 1987).

The USFS has four designated wilderness areas within the study area (**Figure 3-17**): 90,000-acre Ruby Mountains Wilderness, located approximately 55 miles southeast of the Project area; East Humboldt Wilderness, approximately 60 miles east of the Project area; Jarbidge Wilderness, approximately 85 miles northeast of the Project area; and Santa Rosa-Paradise Peak, located approximately 75 miles northwest of the Project area in Humboldt County.

ACCESS AND LAND USE

The primary study area for access and land use is the Leeville Project area (**Figure 2-2**), however, portions of Elko and Eureka counties are also addressed in this section.

ACCESS

The Leeville Project is located approximately 20 miles northwest of Carlin and is accessed via State Highway 766. Highway 766 connects with Interstate 80 south of the Project area in Carlin. The annual average daily traffic on Highway 766 is estimated to be 2,600 vehicles. Access is north from Carlin via State Highway 766 to Simon Creek Road, then north to Carlin Mine. The Leeville Project is located 2 miles north of Carlin Mine along the Barrick Access Road.

The Dunphy Road (also known as Boulder Valley Road) is a secondary road that extends north from the community of Dunphy and accesses the northwest portion of the North Operations Area near the Bootstrap Mine. Eureka County claims the Dunphy Road to the Elko County line. Elko County does not claim the road within its jurisdiction. According to the Nevada Department of Transportation (NDOT), annual average daily traffic in 1997 at the west-bound off-ramp from Interstate 80 onto Dunphy Road was 345 vehicles. From the east-bound off-ramp, the traffic count at the Dunphy ramp was 100 vehicles per day. These statistics represent a two-fold increase in traffic at the Dunphy interchange compared to 1996 (NDOT 1997).

There are no BLM-designated roads in the Project area. The Leeville Project area is dominated by exploration activities and mining, and has numerous haul roads and other support roadways throughout the North Operations Area. Public access to haul roads is restricted for safety purposes.

LAND USE

The Leeville Project is located in Eureka County, Nevada (T35N R50E, portions of Sections 2 and 11 and all of Section 10). In addition, part of the Proposed Action includes a water pipeline that would be located in Sections 8, 10, 15, 16, and 17, T35N, R50E; Sections 1,2,3, and 12, T35N, R49E. Eureka County encompasses 4,182 square miles and is bordered on the north and northeast by Elko County, the west by Lander County, the south by Nye County, and the southeast by White Pine County.

Approximately 81 percent of Eureka County is managed by federal agencies, including BLM, USFS, and BIA. There is no state land in the Project area. Federal land is well consolidated except for a checkerboard of private and federal land on both sides of the Humboldt River and Interstate 80. This land pattern was created when alternating sections of land were granted to the Union Pacific and Central Pacific railroads as incentive to construct a transcontinental railroad. Both private and public land are present within the Project boundary.

Dominant land uses in the Project area include mining, livestock grazing, and, to a lesser extent, outdoor recreation. Although mining has occurred in the area throughout the last century, the majority of mine development has been since 1980. Mining is now the dominant land use in the Project area and will likely remain the principal activity for decades.

Land associated with the Leeville Project, including the proposed pipeline route, is located within the T Lazy S grazing allotment. This allotment has undergone past adjustments to account for withdrawn land parcels due to extensive mining in the area. Current grazing capacity and details of range condition are provided in the *Grazing Management* section of this chapter.

Existing rights-of-way in the Project area include two Barrick access roads (N-54682 and N-48045), two Sierra Pacific Power Company powerline rights-of-way (N-47775 and N-46957), a pipeline and access road granted to Newmont in Section 16, T35N, R50E (N-064876), and a livestock watering pond (N-54209) in Section 2, T35N, R49E granted to the Elko Land and Livestock Company. Rights-of-way are shown on **Figure 2-2**.

Water in Boulder Valley is used for irrigation, stock watering, mining and milling, and domestic purposes. Irrigation and stock watering uses are scattered throughout the Boulder Valley, whereas mining and milling occur primarily in the upper reaches of Boulder and Rodeo creeks, where most of the active mines are located. Other nearby mining and milling water uses are located on the east side of the Tuscarora Mountains in the South Operations Area. Most domestic uses are associated with the various mine operations (BLM 1993b).

NOISE

Perception of noise is affected by intensity, pitch, and duration. Loudness is measured in decibels (dB). On this scale, human perception of sound is linear. The sound spectrum (the plot of amplitude vs. frequency) of a sound must be weighted by the auditory function of an animal to characterize its audibility (Bowles 1995). The Environmental Protection Agency (EPA) recommends the A-weighted scale to describe environmental noise because it emphasizes frequencies that humans hear best, is accurate, convenient, and used internationally (EPA 1978).

Sound attenuates (fades) as it travels from a source to a receiver. Attenuation is a function of the square of the distance, but is also dependent upon other factors, such as altitude of the source, temperature, humidity, wind speed, terrain, and vegetation (Bowles 1995). The noise heard by a human or an animal is dependent on these variables, and upon other factors, such as ambient noise, and the auditory system and physiology of the animal.

Because of the remote location of the Leeville Project, no measurements or estimates of baseline sound were made at the proposed mine site. The nearest residential noise receptor area is Carlin, approximately 20 miles southeast. Carlin is located along Interstate 80 and is affected by traffic noise from the highway as well as normal urban sounds.

Noise generated by trucks, dozers, and other equipment generally ranges from 85 to 90 dBA (A-weighted decibel sound scale) at the source. Sound levels from blasting range from 115 to 125 dBA at 900 feet. **Table 3-25** shows typical noise levels generated by mining equipment; for comparison, **Table 3-26** lists noises frequently experienced in daily activities.

TABLE 3-25
Average Sound Levels for Equipment and Mine Operations

Equipment/Operation	Sound Level[1]	Source of Information
Blasting	115-125 dBA @ 900 feet	United States Bureau of Mines 1976
Haul Trucks	90 dBA @ 50 feet	EPA 1978
Loaders	87 dBA @ 50 feet	Reagan and Grant 1977
Blasthole Drilling	86 dBA @ 50 feet	Reagan and Grant 1977
Dozers	85 dBA @ 50 feet	Reagan and Grant 1977

[1] dBA = A-weighted decibel sound scale.

TABLE 3-26
Relative Scale of Various Noise Sources and Effect on People

Public Reaction	Reference Level	Noise Level (dBA)[1]	Common Indoor Noise Levels	Common Outdoor Noise Levels
		110	Rock band	
		105		Jet flyover @ 1000 ft.
Local committee activity with influential or legal action		100	Inside New York subway train	
		95		Gas lawn mower @ 3 ft.
Letters of protest	4 X as loud	90	Food blender @ 3 ft.	
Complaints likely	2 X as loud	80	Garbage disposal @ 3 ft., Shouting @ 3 ft.	Noisy urban daytime
Complaints possible	Reference	70	Vacuum cleaner @ 10 ft.	Gas lawn mower @ 100 ft.
		65	Normal speech @ 3 ft.	Commercial area, heavy traffic @ 300 ft.
Complaints rare	½ as loud	60	Large business office	
Acceptance	¼ as loud	50	Dishwasher in next room	Quiet urban daytime
		40	Small theater, large conference room	Quiet urban nighttime
		35		Quiet suburban nighttime
		33	Library	
		28	Bedroom @ night	
		25	Concert hall (background)	Quiet rural nighttime
		15	Broadcast and recording studio	
		5	Threshold of hearing	

[1] dBA = A-weighted decibel sound scale.
Source: Hatano 1980.

VISUAL RESOURCES

The study area for visual resources includes all land areas from which the Proposed Action and Alternatives would be visible. This includes the northern portion of Little Boulder Basin and the western slopes of the Tuscarora Mountains. The dewatering pipeline corridor would be visible from portions of Boulder Valley.

The landscape of the study area is characterized by broad, open vistas framed by scattered hills and mountain ranges. The Project site is hilly terrain on the western slope of the Tuscarora Mountains, which rise abruptly to over 7,500 feet AMSL. The Leeville Project lies in the upper Little Boulder Basin, an area with numerous mining facilities.

The study area vegetation consists primarily of homogenous patterns of sagebrush-grassland. Natural vegetation patterns are disturbed by active mining operations and reclaimed mining sites. Dominant vegetation colors are gray, gray-green, and olive green.

Soil and rock are exposed in numerous areas where vegetative cover is sparse or has been disturbed by mining activities. Soil color ranges from chalky off-white to beige. Disturbed soil exhibits a wider range of color including black, dark gray, reddish brown, buff, and chalky white.

Color hues of disturbed soil are stronger than those of undisturbed areas, and exhibit much greater variation. These colors contrast strongly with surrounding soil and vegetation. Rocks vary in color from light brown to dark brown to burnt orange.

The existing mine disturbances (mine pit and waste rock area) in the vicinity of the Leeville Project create moderate to strong contrasts with horizontal lines, smooth surfaced blocky and pyramidal forms, and more vivid colors from disturbed soil and rock. Existing disturbance at the Leeville Project consists of exploration roads, drill pads, and small pits. Existing mining facilities in Little Boulder Basin create moderate to strong contrasts with the forms, lines, and colors of the existing landscape.

Views of the proposed Leeville Project are limited due to adjacent hilly terrain. Distant views are limited to the upper regions of the Tuscarora Mountains. Potential viewers of the Project site include mine workers, supply haulers, and recreationists. The latter would view the Project site from nearby mountain areas. Recreationists include hunters and, to a limited degree, sightseers.

VISUAL RESOURCE RATINGS

BLM has developed the Visual Resource Management (VRM) system to classify visual resources based on scenic quality, visual sensitivity, and visual distance zones. Land in the study area is assigned to VRM Class III and IV (**Table 3-27** and **Figure 3-18**). Of the four VRM classes, Class IV allows the greatest modification of the landscape by disturbance or development (BLM 1986a). The portion of the Project located on VRM Class III land lies in the headwaters of Rodeo Creek. Views of these facilities would be limited due to terrain.

Key observation points (KOP) were selected for evaluating the visual contrast ratings presented in Chapter 4 - *Visual Resources*. Factors considered in selecting KOPs included angle of observation, number of viewers, duration of view, relative apparent size of the project, season of use, and lighting conditions (BLM 1986b). The KOPs were selected to represent locations on roads approaching the Project site from which a person may be expected to view project features. Three KOPs were identified and evaluated (**Figure 3-18**).

KOP 1 is located along the Barrick Access Road approximately 1,500 feet south of the northeast corner of Section 10, T35N R50E. The Barrick Road provides access to the Project site from the Carlin Mine area. This KOP represents views seen by supply haulers and workers traveling to the various mining operations in the Little Boulder Basin. KOP 1 overlooks the western portion of the Project site with views of proposed facilities extending for approximately 1 mile across Little Boulder Basin. Surrounding hills limit distant views from KOP 1. Foreground views of the water treatment facility, waste rock facility, and refractory ore stockpile would be dominant.

TABLE 3-27
Visual Resource Management Objectives

Class	Objective
I	The objective of this class is to preserve the existing character of the landscape. This class provides natural ecological changes, it does not preclude limited management activity. The level of change to the characteristic landscape should be low and must not attract attention.
II	The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract attention of the casual observer. Any changes must repeat the basic elements of form, line, color and texture found in the predominant features of the characteristic landscape.
III	The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant features of the characteristic landscape.
IV	The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. The impacts of these activities should be minimized through careful location, minimal disturbance and repetition of the basic elements.

Source: BLM 1986b

The characteristic landscape is flat in the foreground and middleground, and hilly in the background. Landforms are generally rounded. Exposed soil and rock colors are reddish brown to dark gray, with vegetation colors ranging from gray-green in the foreground to gray, tan, buff, and yellowish tan in the background. Textures are generally smooth. Existing mining operations offer moderate to strong contrasts in form and color. Existing ore stockpiles and waste rock facilities introduce horizontal and diagonal lines along with black, dark gray, and beige colors. The Beast Pit highwall offers moderate contrasts in texture (**Figure 3-19**).

KOP 2 is located along the Barrick Access Road approximately 0.75 mile north of KOP 1. Views of the waste rock disposal facility and water treatment plant would be dominant from KOP 2. The production shaft area and headframe would also be visible from KOP 2. The characteristic landscape features bold, rounded forms with diagonal, curving lines. Vegetation offers no distinct form. Colors of exposed soil and rock range from gray and dark brown to black. Vegetation colors are gray to yellow buff with a smooth texture. Existing mining facilities offer moderate contrasts in form and color, introducing horizontal and diagonal lines and dark gray and black colors (**Figure 3-19**).

KOP 3 is located on a ridge west of the Leeville Project area, above the Beast and Sold mine pits. The Project site is viewed from a higher elevation than KOPs l and 2. This vantage point allows views of the entire Project site, as well as extensive views of the dewatering pipeline corridor and existing mining facilities. These provide moderate to strong visual contrasts, especially in form, line, and color. In the fore-ground-middleground zone, bold rounded forms grade into domed, undulating forms in background mountains. Lines are complex, with horizontal, rounded, and weak to moderate diagonal lines in the background zone. Coarse, patchy textures in the foreground-middleground zone grade into smoother textures in the background zone. Dominant colors on undisturbed land are gray, buff, gray-green, and yellowish tan. In contrast, dominant colors on disturbed land are reddish brown, brown, dark gray, and black. Textures are more patchy on disturbed land (**Figure 3-19**).

CULTURAL RESOURCES

Cultural resources are locations of past human activity, occupation, or use. Prehistoric resources reflect activities that occurred prior to introduction of written records. Historic resources reflect Euro-American and Asian-American occupation. The scientific value of these resources relates to their potential to inform how human societies operate and change. Since written documentation is absent, archaeological sites are the only source of data concerning prehistoric societies. In addition to their scientific value, cultural resources may have aesthetic and cultural value. Aesthetic values may be expressed in rock art sites found throughout Nevada, or in standing structures of architectural significance. Historic sites may have cultural value if they link a living community to a place that conveys a sense of cultural identity. For purposes of this review, a study area was defined that included the greater Carlin Trend. This area extended from Carlin on the south to Willow Creek on the north, and from the Independence Range on the east to the Sheep Creek Range on the west.

PREHISTORIC OVERVIEW

James (1981), Tipps (1988), Elston and Budy (1990), Elston and Drews (1992), and Schroedl (1995) provide overviews of regional prehistory. Schroedl (1995) divides regional prehistory into six chronological periods.

The Pre-Archaic Period (12,250 to 8000 B.C.) was a period marked by cool, moist conditions. Originally thought to represent an adaptation to pluvial lakeshore environments, Pre-Archaic sites have increasingly been recognized in other settings. Subsistence revolved around lake shore-marsh resources and the taking of large game. Population density was quite low, and groups were highly mobile. No sites ascribed to this period have been identified in or adjacent to the Project area.

Environmental conditions changed toward the end of the Pre-Archaic Period as temperatures increased and available surface water decreased. The Early Archaic Period (8000 to 4500 B.C.) appears to have been a time of limited occupation in the north-central Great Basin. Period sites are not common regionally and few have been identified in or near the Project area.

Figure 3-18

blank

Figure 3-19

blank

The appearance of ground stone implements is evidence of subsistence diversification brought on by reduced carrying capacity of local environ-ments. The variety of site types encountered increased during this period, again suggesting resource procurement strategy diversity.

The Middle Archaic Period (4500 to 850 B.C.) corresponds to the onset of a cooler period when increased precipitation caused the expansion of some resources associated with lakes and marshes. Local manifestations of the Middle Archaic Period are referred to as the South Fork Phase. Trends during the period include population increases and broadening economic activities. While hunting was an important subsistence focus, the processing of plant food took on greater importance as evidenced by the abundance of ground stone artifacts. Also, use of upland resources increased notably. Sites assigned to this period are present in the region and are especially abundant in the Tuscarora Mountains south of Richmond Summit.

The Late Archaic Period (850 B.C. and A.D. 700) corresponds with the James Creek Phase. Technologically, this period is marked by increased diversification in ground stone artifacts and a greater emphasis on use of small flake tools. Subsistence and settlement changes appear to reflect increased local and regional population. This prompted an intensification and diversification in localized subsistence practices. Resources seldom used during earlier periods were added to the diet. Regional use of pinyon also became pronounced during this period. Sites associated with this period are numerous in the immediate region, especially in the Little Boulder Creek area north of the Project area.

The Late Prehistoric Period (A.D. 700 to A.D. 1300) corresponds with the Maggie Creek Phase and exhibits a general continuity with the previous era. Occupation levels were consistent with, if not higher than, previous periods. Appearance of smaller Rosegate series projectile points suggests that the bow and arrow were introduced during this period. A general emphasis on smaller tools may be evidence of gradual diminishment of quality lithics in the region. An alternative explanation is that a burgeoning population forced an increased reliance upon the taking of smaller animals.

The Protohistoric Period extended from A.D. 1300 to historic times and corresponds with the Eagle Rock Phase. Occupational levels appear to have declined during this period; assemblages are small and lack evidence of much diversity. Local materials are not abundant, suggesting a fairly mobile subsistence practice. This period saw expansion of Numic groups throughout most of the Great Basin from a homeland in the Southwest. While there is little dispute that this event occurred, there is disagreement over its mechanics and timing.

HISTORIC PERIOD

Patterson, Ulph, and Goodwin (1969) and Vlasich (1981) address local history. Topical references of relevance include Cline (1963) on early explor-ation; Cline (1974) on the Hudson's Bay Com-pany; Goodwin (1965) on emigration; Myrick (1962) on railroads; Lincoln (1923), Hill (1918), and Elliot (1966) on mining; and Vestrom and Mason (1944), Sawyer (1971), and Young and Sparks (1985) on ranching and agriculture.

Economic interests fostered early exploration of the region. Acting on behalf of the Hudson's Bay Company, Peter Skene Ogden made several incursions into the Great Basin during the 1820s and 1830s. During his fifth such exploration (in 1828 and 1829), he traversed portions of the Maggie Creek drainage before traveling north into the Owyhee drainage. Others who explored the general Humboldt region included John Work and Joseph Walker. Exploration of a different sort occurred during the 1840s through the 1860s, when military expeditions traversed the region in search of scientific information or transportation routes. Leaders of these expeditions included Captain John C. Fremont, Lieutenant E. Beckwith, Captain James Simpson, Clarence King, and Lieutenant George Wheeler.

Beginning in the 1840s, Euro-Americans moved through Nevada on their way to Oregon and California. The number of people moving along these trails swelled in the 1850s and 1860s after the discovery of gold in California and Nevada. The first Euro-American settlers in Nevada were traders who established posts along emigrant trails. Farmers, ranchers, and miners moved out from these posts into the hinterlands. Construction of the transcontinental railroad in the 1860's established new population centers and incentives for local and regional development. Nearby Carlin was established as a major railroad facility. Ponds along the Humboldt River and Maggie Creek produced ice for use by the railroad.

Ready access to the railroad spurred development of the livestock industry throughout the state, especially in northeast Nevada. Access to regional and national markets prompted an increased demand for extensive rangeland. Ranching operations in northeast Nevada came to depend on the availability of land for summer and winter pasture. This pattern continued into the 1890s, after which the character of ranching shifted due to changes in federal land management, regional and national economics, and private land ownership patterns.

Mining has played a major role in the history of northeast Nevada. The Project area is a part of the Lynn District established in 1907 when placer gold deposits were discovered in the Lynn Creek drainage. To the north of the Lynn District were the Boulder Creek (Bootstrap), Ivanhoe, and Gold Circle districts. The Boulder Creek District was a comparatively late development, dating to the 1950s and 1960s. The Ivanhoe District was known for mercury deposits mined during the first half of the 20th century. Of the local mining districts, Gold Circle (Midas) was the most lucrative. Significant amounts of gold and silver were produced between 1907 and 1922. Production was halted by the onset of World War II. The Maggie Creek District was located south and east of the Lynn District. Established in 1906, the district was the scene of intermittent activity through the 1920s. Limited amounts of silver, lead, copper, and gold were produced. Lignite coal and oil shale were mined on a limited scale near Carlin as early as the 1860s and continued into the 20th century. Carlin also saw some gold production in 1908 and again in 1934.

CULTURAL RESOURCES IN THE AREA OF POTENTIAL EFFECT

Compliance with regulations affecting cultural resources requires definition of an Area of Potential Effect. For analytic purposes, the Area of Potential Effect is divided into two sub-areas: Area of Direct Effect and Surrounding Area of Effect. The Area of Direct Effect is the area where proposed surface disturbance or occupancy would occur as described in the Proposed Action and Alternatives. The Surrounding Area of Effect lies outside the Area of Direct Effect but may be subject to impact even though no surface disturbance is proposed. For example, some resources may be impacted due to the introduction of visual or audible intrusions (**Figure 3-20**).

Archival data were collected to determine location and nature of prehistoric, historic, and architectural resources known to be present within the Area of Potential Effect. Project and site records maintained by BLM were examined. Archival research indicated the immediate mine area had been inventoried previously. Twelve intensive inventories were conducted within or overlap some portion of the Area of Direct Effect (see **Table 3-28**). Only portions of the proposed dewatering pipeline/canal alignment had not been inventoried. The subsequent examination of those areas is documented in BLM Report BLM1-1652(P) (Newsome 1997). Viewed collectively, these inventories address all of the Area of Direct Effect. Forty-one additional inventories extend into the Surrounding Area of Effect (see **Table 3-28**).

Prehistoric and historic period cultural resources identified as a result of Class III inventories in each sub-area of the Area of Potential Effect are listed in **Table 3-28**. A total of 335 sites have been recorded, of which 31 are partially or completely within the Area of Direct Effect. None of the sites identified in the Area of Direct Effect are eligible or potentially eligible to the National Register of Historic Places. One site (CrNV-01-10801), a multi-component prehistoric site, located in the Surrounding Area of Effect near the proposed pipeline and canal system has been determined eligible to the National Register of Historic Places by BLM.

A total of 304 cultural resources have been identified in the Surrounding Area of Effect. Of the identified sites, 22 have been determined eligible for the National Register; data recovery has occurred at three of those sites. One site is listed as potentially eligible and 137 have been determined ineligible for the National Register. A determination has not been made for the remaining 145 sites. Given provisions of the Statewide Agreement between BLM and the

Figure 3-20

blank

TABLE 3-28
Cultural Resource Inventories Entirely or Partially Within the Leeville Mine Area of Potential Effect

BLM Report Number	Author	Date of Report	Number of Sites Located			Correspondence	
			Large – Lithic Sites	Small Sites	Isolates	BLM Decision	SHPO[1] Concurs
Area of Direct Effect							
1126	Johnson, F.	1987	0	0	0	-	-
1148	Hubbard, T.	1988	0	0	0	-	-
1160	Coulam, N.	1988	0	1	0	-	-
1209	Botts, S.	1988	0	0	0	1/4/89	1/20/89
1287	Tipps, B. and G. Popek	1990	0	0	1	5/18/90	5/31/90
1567	Newsome, D.	1992	17	0	11	9/1/92	9/28/92
1628	Newsome, D.	1992	0	0	0	2/26/93	3/22/93
1636	Stratford, M.	1996	0	0	0	-	-
1652	Newsome, D.	1997	0	0	1	-	-
1942	Kenzle, S.	1994	0	0	0	10/26/94	11/8/94
1944	Stratford, M.	1994	0	0	0	-	12/8/94
2026	Newsome, D.	1996	0	0	0	9/27/96, 4/24/97	10/30/96, 5/30/97
Totals			**17**	**1**	**13**		
Surrounding Area of Potential Effect							
151	Peterson, H.	1978	0	0	0	-	-
388	Jaynes, S. and T. Murphy	1981	2	1	0	-	-
902	Spencer, L.	1985	0	0	0	-	-
967	Matranga, P., D. Mathiesen, & P. deBunch	1985	0	0	0	-	-
1040	Schroedl, A.	1986	5	11	3	-	-
1042	Russell, K., A. Tratebas, and A. Schroedl	1986	0	0	0	12/18/86	1/21/87
1126	Johnson, F.	1987	0	1	4	-	-
1148	Hubbard, T.	1988	0	0	0	-	-
1160	Coulam, N.	1988	1	0	0	-	-
1188	Tipps, B.	1988	0	0	0	-	-
1209	Botts, S.	1988	2	4	3	1/4/89	1/20/89
1241	Hicks, P. and S. Livingston	1988	0	0	0	1/4/89	1/20/89
1244	Hicks, P.	1989	3	8	11	10/5/89	9/24/91
1248	Young, B.	1989	1	4	2	-	10/18/89
1287	Tipps, B. and G. Popek	1990	10	11	16	5/18/90	5/31/90
1323	Schroedl, A.	1990	6	5	5	10/28/91	9/24/91, 11/8/91
1345	Popek, G.	1990	3	2	5	8/28/92	9/29/92
1443	Tipps, B.	1991	15	6	13	1/27/93	2/1/93
1465	Nelson, K.	1991	0	0	0	8/26/92	9/4/92
1544	Newsome, D. and B. Tipps	1992	0	0	0	5/6/92, 6/17/92 8/28/92	6/4/92, 9/30/92
1567	Newsome, D.	1992	16		4	9/1/92	9/28/92
1628	Newsome, D.	1992	15		10	2/26/93	3/22/93
1636	Stratford, M.	1996	10			-	-
1637	Newsome, D.	1996	4		5	-	-
1644	Newsome, D., G. Popek, and B. Tipps	1993	4	0	3	5/14/93	6/1/93
1684	Tipps, B., G. Popek, and D. Kice	1993	0	0	0	1/20/94	1/25/94
1689	Newsome, D.	1992	12		5	1/26/93	2/1/93
1725	Newsome, D.	1993	3		3	3/24/94, 4/20/94	4/7/94, 5/20/94
1788	Kautz, R.	1993	0	3	5	1/18/94	1/25/94
1800	Newsome, D., G. Popek, and B. Tipps	1993	15		8	8/1/94, 10/7/94	8/10/94, 11/16/94
1807	Kenzle, S.	1993	1		1	3/24/94, 4/20/94	4/7/94, 5/20/94
1867	Newsome, D.	1994	0	0	0	-	12/5/94
1889	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1905	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1921	Stadelman, J.	1994	0	0	0	-	-
1926	Newsome, D.	1994	0	0	0	8/19/94	8/29/94
1942	Kenzle, S.	1994	2	0	3	10/26/94	11/8/94
1944	Stratford, M.	1994	0	0	0	-	12/8/94
2026	Newsome, D.	1996	4	0	5	9/27/96, 4/24/97	10/30/96, 5/30/97
2027	Newsome, D.	1996	0	0	0	-	-
2028	Newsome, D. and E. Tallman	1996	0	0	0	-	-
Totals			**134**	**56**	**114**		

[1]SHPO – State Historical Preservation Office

Nevada State Historic Preservation Office, isolates are by definition not eligible to the National Register.

Of the approximately 68 square miles contained in the Area of Potential Effect, some 35 square miles have been subject to Class III inventory. As noted above, 335 cultural resources have been identified as a result of that inventory effort. This reflects a site density of 9.6 sites per square mile. Site density estimates have been developed for areas immediately north and south of the Project area. In the South Operations Area, inventories suggest a site density of about 2.7 sites per square mile. This estimate increases to 6.4 sites per square mile in areas located along drainage ways (Newsome and Tipps 1997). Site densities are notably higher in the Little Boulder Basin. Newsome and Tipps (1997) report a site density of 17 sites per square mile, while Burke (1990) suggests a density of 21 sites per square mile. Noted differences in site densities may be due to the differing availability of water. Little Boulder Basin has several perennial drainages and springs, and archaeological sites are abundant. In contrast, terrain in the South Operations Area is more rugged and fewer sources of water are available. Fewer archaeological sites have been identified in this context. Site densities noted for the Area of Potential Effect are intermediate between those noted for the adjacent areas.

NATIVE AMERICAN RELIGIOUS CONCERNS

Ethnographic resources include sites or areas of concern to Native American groups either for heritage or religious reasons. A site may have a heritage value if it serves as a link between a living community and a place that conveys a sense of cultural identity, or a particular social or religious concern has been expressed regarding the site.

Newe/Western Shoshone History

The Leeville Project area lies within the ethnographic territory of the Western Shoshone, or Newe. Ethnographic sources include Chamberlain (1911), Steward (1937, 1938, 1941, and 1943), and Harris (1940). Murphy and Murphy (1960), the Inter-Tribal Council of Nevada (1976), Janetski (1981), Thomas, et al. (1986), and Crum (1994) provide recent ethnographic reviews. Information on worldview and religious beliefs is contained in Miller (1983a, 1983b), Hultkrantz (1986), Clemmer (1990), Rusco and Raven (1992), and Deaver (1993).

The Newe/Western Shoshone, members of the Uto-Aztecan linguistic family, inhabited an area extending from southeast California into northwest Utah. Their territory was bordered to the north by the Northern Shoshone, to the east by the Ute, to the south by the Southern Paiute, and to the west by the Northern Paiute. The nuclear family was the basic unit of Shoshone society. Nuclear families conducted most subsistence activities and were largely self-sufficient. Three to ten families jointly occupied semi-permanent camps during the winter months and foraged together for parts of the year. The Shoshone joined into larger groups only when resources were sufficiently concentrated to allow cooperative harvests. These gatherings were often the occasion for fandangos, festivals that provided an opportunity for courtship, socializing, and dancing.

The Shoshone utilized a flexible subsistence and settlement system, one based on the scheduling of activities according to the seasonal availability of food. In the spring, Shoshone dispersed in family groups each of which foraged for greens and roots on valley floors. Small mammals were an important meat source. These could be hunted with bow and arrow, snares, or deadfalls. Sometimes, their burrows were flooded or dug out. Individual hunters stalked deer.

Summer gathering strategies focused on ripening grass seeds. These became available on valley bottoms first and then upslope as the season progressed. Seeds were harvested either by knocking them into burden baskets or by cutting seed heads from stalks. Seeds were winnowed, ground, and either prepared for consumption or stored. Berries and roots were gathered in late summer and early fall. Small animals continued to be an important resource throughout the summer. Small groups ambushed mountain sheep from blinds.

The character of the subsistence pattern changed in the fall. Multiple families assembled to procure large amounts of food for storage at winter base camps. Pinyon was an important plant resource in the fall. Long hooked poles were used to shake cones from trees, while others could be picked from the ground. As necessary, cones were roasted to release the seeds. Cones often were stored in aboveground caches or open pits, while nuts were stored in sealed underground pits. Pinyon were sparse in areas north of the Humboldt River. Groups often traveled long distances to secure seeds, which were then transported to winter village sites. After the pinyon harvest, people sometimes gathered for pronghorn antelope and jackrabbit drives on valley bottoms. Jackrabbits were driven into nets and clubbed. Pronghorn antelope were driven into large corrals where archers dispatched them. Newe/Western Shoshone also made occasional forays to the Snake River to fish for salmon during the fall spawning run.

The Shoshone depended on stored food during winter months. Pinyon and other stored seeds could be supplemented by collecting cactus and the roots of marsh plants such as cattails and bulrush. Mountain sheep could be hunted at lower elevations in the winter and ice fishing sometimes occurred along the Humboldt River.

Newe/Western Shoshone World View

The Newe/Western Shoshone trace their occupation of the Great Basin back to when the earth was young - when "animals were people" (Miller 1983a). The coyote and wolf figure in creation stories, with prominent mountain peaks honored as sacred places connected with their creation.

The belief that supernatural power (*Puha*) has permeated the earth since its creation is a central feature in Newe/Western Shoshone religious beliefs. Religious behavior revolves around the acquisition of *Puha*. Sources of *Puha* are numerous, including sources of water, prominent mountain peaks, and caves. Animals and, to a lesser extent, plants have power, and this power can be conveyed to people by supernatural spirits who control individual species. Because power is attracted to life, it remains present in places where people have lived, particularly around graves. Power sources are associated with spirits. As noted, animal and plant species have their spirits, and fixed places such as water sources, mountains, caves are viewed as power spots. Other forms of spirits include guardian spirits and little men.

Religious expression takes several primary forms, including ceremonies; individual prayer to the spirits of plants, animals, water, power spots, and little men; and use of power spots for vision questing (acquisition of a guardian spirit), curing, and doctoring. The most frequent form is the individual prayer. Prayers are especially important in connection with places where spirits may live, or that are regarded as power spots. People who exhibit discipline and strength may obtain special power. For example, the shaman may obtain the power to heal illnesses or injuries. Relatively few people have special powers. Most people participated in a variety of rituals associated with hunting, gathering, attending a birth, or burying and mourning the dead.

Power also may be used for non-legitimate, malevolent purposes. Certain spirits may, in some circumstances, act in a malevolent manner. For example, little men can be benevolent or malevolent, depending on how they are treated. Correcting neglected or abused relationships between humans and spirits is a major aspect of Newe/Western Shoshone religion. Many rituals are directed at controlling and use of power and balancing the potentially dangerous spiritual powers that pervade nature. Shoshone religion depends on maintaining the integrity of power spots, maintaining the presence of little men, maintaining their relationship with the owner-spirits of plants and animals, and maintaining life-giving forces such as the sun, earth, and water.

Consultation

Specific laws, regulations, and executive orders mandate that federal agencies consult with Native American communities about projects that could effect traditional cultural or religious beliefs, or practices. These include the National Historic Preservation Act, the Native American Graves Protection and Repatriation Act, and Executive Order 13007, among others.

Previous consultation with members of the Newe/Western Shoshone community was documented in a report entitled "*Consultation With the Western Shoshone Regarding the*

Proposed Expansion of Newmont Gold Quarry Mine, Carlin, Nevada" (Deaver 1993), and was subsequently integrated into BLM (1993b). Since general ethnographic inquiry tends to be broad in scope, the BLM (1993b) addressed issues relevant within the area of direct effect and the area of cumulative effect. Neither area was discussed individually.

Based on consultation conducted in 1993, the following statements characterize the general concerns of Newe/Western Shoshone traditionalists as they pertain to mining activities.

- Ground-disturbing activities associated with mining can disrupt the flow of spiritual power (*Puha*) as well as the distribution or disposition of spirits (e.g., Little Men and Water Babies). Maintaining access to undisturbed concentrations of *Puha* (power spots) and continuing relationships with the spirits is integral to spiritual life.

- Dewatering efforts, with the resultant reduction or loss of flow to springs, could alter the distribution or disposition of spirits associated with water. Maintaining a relationship with these spirits is integral to spiritual life. Spring water is used medicinally, for drinking, as a sacrament, and in prayer. In addition, some springs are a source of sacred white clay, and burials often take place near these springs.

- Ground disturbance results in loss of plants and minerals used by Newe/Western Shoshone traditionalists.

- Cultural resource inventories conducted by archaeologists prior to mining activities often result in the collection of artifacts that Newe/Western Shoshone traditionalists consider as powerful and sacred objects (e.g., complete projectile points and items of Tosawihi chert). Current curation practices can prevent traditionalists from securing these items for use in healing practices.

Additional consultation for the Leeville Project has occurred in two phases. Phase I was initiated via certified letter on May 22, 1997. The Te-Moak Tribe; Elko, Wells, Battle Mountain, and South Fork Band Councils; and Western Shoshone Historic Preservation Society were invited to discuss potential effects of ground-disturbing activities associated with the Leeville Project on areas of cultural or religious importance to the Shoshone people. BLM received two written responses. The South Fork Band of the Te-Moak Tribe indicated it had no comments or concerns regarding the Project. The Western Shoshone Historic Preservation Society stated the Project would occur within traditional boundaries of the Newe/Western Shoshone. The Society contends that because the Ruby Valley Treaty of 1863 is the "law of the land", the Leeville Project is illegal. As a result, the Society stated it does not support the proposed activity. Further, the Society states there are contemporary, prehistoric, and historic campsites that lie within traditional boundaries of the Newe/ Western Shoshone. The Society con-cludes its letter by stating, "The proposed Leeville Project lies within these boundaries, therefore, such a project will in fact have a direct impact on the cultural resources of the Native American Indian."

None of the remaining groups provided a written response. In each case, they were contacted by telephone and asked to provide written comment on the Proposed Action. Repeated attempts by BLM to solicit comments from the groups were unproductive. Consequently, Phase I of the consultation effort did not result in identification of traditional, cultural, or religious sites of importance to the Newe/Western Shoshone. Evidence of BLM's effort to consult in good faith regarding potential effects of the Leeville Project on Western Shoshone cultural, religious, and spiritual areas are outlined in **Appendix A**.

Phase II of the consultation effort was conducted in conjunction with the mine dewatering cumul-ative impact assessment prepared on behalf of Newmont's Gold Quarry and Leeville projects, and Barrick's Betze/Post operation (BLM 2000a). This consultation effort was initiated on October 1, 1998. To date, the main finding of Phase II consultation is the identification of two traditional cultural properties, one along Rock Creek and one at the Tosawihi Quarries. The BLM determined the Rock Creek area was eligible for the National Register as a traditional cultural property under criteria *a, c,* and *d*, and the Tosawihi Quarries area was eligible for the National Register as a traditional cultural property under criteria *a* and *d*. In a letter dated May 19, 1999, the Nevada State Historic Preservation Office concurred with the BLM's determinations. The Western Shoshone expressed concerns about possible effects of dewatering to the traditional cultural properties at Rock Creek and Tosawihi. The Newe/Western Shoshone also expressed concern about the declining number of sage grouse, the loss of native plants and animals, and impacts to water resources.

SOCIAL AND ECONOMIC RESOURCES

The socioeconomic study area encompasses portions of Elko and Eureka counties, the communities of Elko, Carlin, and Spring Creek, and the Elko Band Colony. Since the Project is situated within Eureka County and local government would receive increased tax revenues as a result of the Project, this section describes economic conditions in Eureka County. The majority of employees and their families are expected to live in Elko County, rather than Eureka County, due to long commuting distances between the project and communities within Eureka County. Therefore, social life and community services, which will have negligible impact as a result of the Project, are not described for Eureka County. A socioeconomic technical report was prepared and is available at the BLM Field Office in Elko.

SOCIAL LIFE

Mining and related development in the 1980s and 1990s caused rapid population growth in Elko and Carlin and was a dominant force in shaping the socioeconomic character of the area. The in-migration of newcomers created changes in some aspects of daily life, such as increased traffic, overcrowded parks, and higher crime rates. In a more positive light, low unemployment rates, greater diversity of services, and increased business opportunities also were a result of increased economic development.

Local residents enjoy the small-town atmosphere and are proud of the area in which they live. Residents appreciate the quiet and friendly neighbors, peaceful country living, natural environ-ment, and outdoor recreational opportunities. Some residents, however, perceive negative features of the area such as inadequate selection of goods and services, isolation from major urban centers, lack of ample recreational activities for youth, severe climate, lack of trees, and environmental changes created by mining activities. Residents sense that law enforcement is handling social problems such as domestic violence, alcohol or other drug abuse, and excessive gambling; however, improved access to counseling and more recreational opportunities are needed to further reduce these problems.

Social stratification in the area is often defined by income, length of residence, educational attainment, and ethnicity. Local residents earning high incomes are considered to be the most influential in the community. The most powerful groups viewed by residents as making decisions about the area's future include federal and state government, county commissioners, environ-mental organizations, and large corporations.

The effects of declining gold prices have been felt by the mining industry, businesses, local governments, and residents. As gold prices remain in a slump, the community experienced layoffs of mine workers, some mines announced early closures, and exploration and mine expansion plans were shelved. As mine workers were laid off, local business establishments also experienced a decrease in local spending by unemployed mine workers and their families.

POPULATION TRENDS AND DEMOGRAPHIC CHARACTERISTICS

Nevada experienced dramatic growth during the past decade, ranking it as the fastest growing state in the country with a 51 percent growth rate compared with a 9.6 percent rate nationwide. In-migration accounted for 81 percent of the population increase.

Similar to the state, Elko County's population grew from 33,530 in 1990 to 45,291 in 2000, a 35 percent increase over the past decade. The City of Elko also experienced an increase of 13 percent in population between 1990 (14,736 residents) and 2000 (16,708 residents) and the "bedroom community" of Spring Creek outside of Elko increased by 80 percent from 5,866 in 1990 to 10,548 in 2000. Population in Carlin, the community closest to the mine site, decreased by 3 percent from 2,220 in 1990 to 2,161 in 2000 (United States Department of Commerce, Bureau of the Census 2001.

The demographics of the Elko County population differ from the state as a whole with respect to gender (higher percent of males than females in the county than in the state); age (a higher population of residents less than 18 years of age in the county than in the state); ethnicity (higher percent of Caucasian and Native American populations in the county than in the state); and poverty (fewer percent of people below the poverty level in the county than in the state).

Tribal enrollment of the Elko Band Colony increased 9 percent between 1995 (1,326 residents) and 1997 (1,445 residents). Forty-three percent of the enrolled members live on or near the colony. In 1997, 29.4 percent of colony residents were under 16 years of age, 64.4 percent were between 16 and 64 years old, and 6.2 percent were 65 years and older (United States Department of the Interior, Bureau of Indian Affairs 2001).

COMMUNITY SERVICE PROVIDERS

Education

Eleven schools are located in the socioeconomic study area, all within Elko County School District. The four elementary schools located in Elko (Elko Grammar School #2, Mountain View, Northside, and Southside) provide education to students enrolled in kindergarten through grade 6. Elko Junior High School serves grades 7 and 8, while Elko High School provides education to students in grades 9 through 12.

Spring Creek students enrolled in kindergarten through grade 5 attend Spring Creek and Sage elementary schools. Spring Creek Middle School provides education for students in grades 6, 7, and 8, while Spring Creek High School serves grades 9 through 12. The Carlin elementary school provides education to students in kindergarten through grade 6, and Carlin High School serves students enrolled in grades 7 through 12.

Education of children in kindergarten through grade 12 from the Elko Band Colony is provided through the Elko County School District. A Head-start Program is housed and operated at the Colony for children aged 3 through 5. Under con-tract with the BIA, the Elko Band Council provides higher education and an adult vocational program at the Colony.

LAW ENFORCEMENT

The Nevada Highway Patrol, Elko County Sheriff's Department, Elko City Police, Carlin City Police, and BIA Police provide law enforcement services to community residents. The Highway Patrol is responsible for law enforcement activities on state highway systems. The Sheriff's Department is accountable for Elko County including the unincorporated towns (17,135 square miles) and is aided in search and rescue operations and emergency situations by the Sheriff's Posse and Reserves. The Elko County Jail, operated by Elko County Sheriff's Department, is located in Elko.

The Elko and Carlin City Police are restricted to the city limits (14.1 square miles and 9 miles, respectively). The BIA Police is accountable for law enforcement on the Elko Band Colony (192.8 acres).

FIRE PROTECTION

Fire protection in the socioeconomic study area is provided by the Elko City Fire Department, Carlin City Volunteer Fire Department (a combined fire, ambulance, and rescue unit), BLM, USFS, and Northeastern Fire Protection Department of the Nevada Division of Forestry. The Elko and Carlin Fire departments primarily serve residents within their respective city limits and the Elko Band Colony; however, both departments maintain mutual aid/cooperative agreements with other firefighting agencies in the area. BLM is primarily responsible for fighting wildland fires.

AMBULANCE SERVICES

Ambulance services are available in Elko and Carlin for ground transportation of patients. Fixed-wing ambulance aircraft also is available at the Elko Airport.

HEALTH CARE

The Northeastern Nevada Regional Hospital (formerly Elko General Hospital) opened in September 2001. The hospital is situated on a 50-acre medical campus and offers 75 acute care rooms. Services at the hospital include 24-hour emergency care, physical therapy, full-service laboratory, intensive care unit, pediatric unit, inpatient pharmacy, obstetrics and gynecology, 24-hour radiology, MRI and CAT Scan, nuclear medicine, mammography, ultrasound, chemotherapy, neurology, inpatient and outpatient surgery, cardio-pulmonary therapy, community outreach programs, pediatric clinic support groups, and nutrition counseling.

The hospital, under contract with Indian Health Service (IHS), provides medical care and emergency services to Native Americans. In addition, comprehensive medical care through IHS is provided at the Elko Band Colony by the Health Center which opened in July 1992. The Center houses a pharmacy, a two-chair dental operatory with a laboratory, and other support services such as a community health nurse, alcohol/drug prevention, and after-care programs.

PUBLIC ASSISTANCE

Public assistance in Elko County is provided by Elko County Social Services and the Nevada State Welfare Department. Other smaller organizations also provide temporary assistance to residents suffering hardships. The Elko Band Council, under contract with the BIA, provides eligible Native Americans with general welfare assistance, adult institutional care, Indian child welfare (including foster care and institutional placements), indigent burial assistance, counseling services, and assistance with Social Security, disability, and death benefits, and state Medicare and Medicaid benefits.

WATER SUPPLY

Elko city water is obtained from 18 deep-water wells. The system has a designed maximum flow capacity of 14.5 million gallons per day (mgpd), with peak usage of 13 mgpd and low usage of 3 mgpd. Water is stored in 10 storage tanks with total storage of 25 million gallons. Natural springs and a deep well provide the city of Carlin with its public water supply. Water is stored in a two-million-gallon tank. The system has a peak flow capacity of 980 gallons per minute (gpm), with an average flow of 450 gpm.

Nine wells throughout the village of Spring Creek provide public water to Spring Creek residents. Water is retained in 7 storage tanks.

WASTEWATER TREATMENT FACILITIES

The Elko wastewater treatment facility is a “fixed-film” biological sewage plant constructed in 1983. The Carlin wastewater treatment facility consists of two lagoons with a reservoir and rapid infiltration basins. The sewage flows by gravity lines into a force main that feeds the aerated treatment lagoons. The treated sewage is used for irrigated pastures and wetlands. Residents and businesses in Spring Creek use septic systems for wastewater disposal.

SOLID WASTE

The city of Elko regional landfill is one of two landfills serving the county. Estimated life of the landfill, at 1,000 tons of solid waste per day, is approximately 94 years. The landfill currently accepts approximately 240 tons of solid waste per day.

HOUSING

In 2000, there were 18,456 housing units in Elko County, of which 85 percent were occupied and 15 percent were vacant housing units. Of the 15,638 occupied units, 70 percent were owner occupied and 30 percent were renter occupied. Housing occupancy in the cities of Elko, Spring Creek, and Carlin ranged from a high of 93 percent in Spring Creek to a low of 78 percent in Carlin, while 89 percent of the housing units in the city of Elko were occupied. Of the occupied housing units, 63 percent were owner occupied in Elko, 89 percent were owner occupied in Spring Creek, and 73 percent were occupied by owners in Carlin (United States Department of Commerce, Bureau of the Census 2001).

In 1997, 41 mobile home parks in Elko County had a total of 1,711 spaces of which 86.9 percent were occupied, 2.1 percent were vacant, and 11.0 percent were mobile homes owned by the parks. Of the 1,711 spaces in the county, 55.4 percent were in Elko, 7.5 percent were in Carlin, and 37.1 percent were located in other communities within the county. In 1996, there were 1,656 motel/hotel rooms in the city of Elko. An estimated 8 percent of the rooms were occupied by individuals on a semi-permanent to permanent basis.

GOVERNMENT AND PUBLIC FINANCE

Major governing bodies in Elko County include Elko County Commissioners, Elko County Planning Commission, Elko County School District, city of Elko, city of Carlin, and the Tribal Council of the Elko Band Colony-Te-Moak Tribe of the Western Shoshone Indians.

The state of Nevada collects taxes on a multitude of items. The primary contributors to the revenue fund are gaming, sales, and use taxes. Relative to the affects of the mining industry on the demand for public services and other industries in Nevada, mining is among the highest taxed industries in the state and the only industry in Nevada that pays taxes to state and local governments on the basis of net proceeds. Mineral producers are allowed to deduct direct costs of production, such as mining and milling, and are taxed on the remaining amount.

The biggest share of fiscal year (FY) 1999-2000 revenues for Elko County, 46.3 percent came from intergovernmental revenues, while property taxes provided about 21.8 percent of Elko County revenues. The majority of the expenditures were for general government (26.6 percent), public safety (21 percent), judicial (17.2 percent), and public works (15.7 percent). Expenditures exceeded revenues in FY 1999-2000 by $2,550,607 (County of Elko 2001).

Approximately 45 percent of Eureka County revenue was derived from intergovernmental revenues in FY 1999-2000, followed by property taxes (37.5 percent). The largest share of expenditures were for general government (26.1 percent), public works (22.8 percent) and public safety (16.1 percent). Revenues exceeded expenditures by $2,064,551 in FY 1999-2000 (County of Eureka 2001).

EMPLOYMENT

The gaming industry drives Nevada's economy; therefore, the hotel, gaming, and recreation sectors employ the most workers in the state. Employment in Nevada in 1999 was dominated by service industries, which accounted for approximately 43 percent of the state's jobs. Wholesale and retail trade, the next largest employment sector, provided about 21 percent of jobs statewide. Approximately 1.2 percent of jobs statewide were in the mining industry (Nevada Department of Employment, Training and Rehabilitation 2001a).

In spite of the recent decline in the price of gold and consequent layoffs and closures in Nevada's mining industry, mining has always been and continues to be important to the economic well-being of Nevada. Over the years, Nevada has led the nation in the production of gold, silver, and barite. In addition to direct employment created by the mining industry, it is estimated that, for every job in the mining industry, at least 1.25 additional jobs are created in the state economy. Using the employment multiplier of 1.25 for indirect jobs and the Nevada 1999 mining employment total of 11,923, an estimated 14,904 indirect jobs were created in the state as a result of mining.

Elko and Eureka counties contribute substantially to Nevada's overall mining employment; collectively, mining jobs in Elko and Eureka counties made up 41 percent of the state's mining jobs in 1999. In 1999, 6 percent of 19,820 jobs in Elko County were in mining, compared with 89 percent of the 4,151 jobs in Eureka County. Employment numbers collected and reported by the Nevada Department of Employment represent the location of a job and not necessarily where employees live. The mining boom along the Carlin Trend, primarily in Eureka County, has greatly contributed to increased commuting for employment between Elko and Eureka counties (i.e., Elko County residents traveling to Eureka County for work). Data indicate that approximately 78 percent of people working in Eureka County commute from other areas of the state or outside of the state (i.e., 4,151 jobs in Eureka County with a labor force of only 900).

In 1999, the largest employer in Elko County was the service industries sector, employing 44 percent of the county's workers, followed by the wholesale and retail trade sector (19 percent) and government (17 percent). In 1999, the county unemployment rate was 5.3 percent, slightly higher than the state rate of 4.4 percent (Nevada Department of Employment, Training and Rehabilitation 2001b).

Unlike the state and Elko County, the major employer in Eureka County was the mining industry in 1999 (89 percent). This sector was followed by the government sector (5.6 percent). The unemployment rate in 1999 for Eureka County was 4.2 percent, which is lower than the state and Elko County.

Basic employers of the Elko Band Colony are the Elko Band Council, the Te-Moak Tribe, the Te-Moak Housing Authority, the Bureau of Indian Affairs, and the Indian Health Service. The Tribe owns and operates a smokeshop and a con-venience store on the Colony and many tribal members work seasonal agricultural and ranching jobs in the area. In 1997, of 250 people employed, one-third were employed in the public sector and the remaining two-thirds were employed in the private sector. Twenty-nine percent of the 352 persons available for work were unemployed in 1997 (United States. Department of the Interior, Bureau of Indian Affairs 2001).

INCOME

Jobs associated with the gaming industry are the most numerous in the state, but most are low paying positions. The statewide average annual wage for service industries in 1999 was $29,103. While there are relatively fewer mining jobs statewide, mining jobs paid the highest wages ($55,744 average annual wages statewide). In 1999, the annual average wage in the mining industry was $58,696 in Elko County, and $55,517 in Eureka County (Nevada Department of Employment, Training, and Rehabilitation 2001c). Per capita personal income in Nevada in 1998 was $29,200, compared with $23,574 for Elko County and $20,718 for Eureka County (United States Department of Commerce, Economics and Statistics Administration 2001).

ENERGY GENERATION AND DISTRIBUTION SYSTEMS

Sierra Pacific Power Company provides electrical service in the study area. Relocation of the existing 120kV transmission line in the Project area would be required in an area to be selected by BLM, Sierra Pacific, and Newmont. To reduce the voltage for distribution to underground and surface support facilities, a substation also may be required at the Project site.

Natural gas in the study area is provided by Southwest Gas Corporation. Southwest Gas Corporation has extended its service to provide Newmont's roaster facility with natural gas; however, service is currently not available at the Project site. The natural gas pipeline has a right-of-way adjacent to Interstate 80 near the Carlin Trend.

ENVIRONMENTAL JUSTICE

Executive Order (EO) 12898 directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs on minority and low-income populations. Minority populations included in the census are identified as Black: American Indian, Eskimo, or Aleut; Asian or Pacific Islander; Hispanic; or other. The low-income level is defined as the percentage of families with an income below the 1990 poverty level. The average poverty threshold for a family of four was $12,674 in 1989.

USEPA (1998) and CEQ (1997) guidelines for the conduct of environmental justice assessments were followed when preparing the present analysis. United States Bureau of Census data were reviewed for the census tract in which the Proposed Action and Alternatives would occur. The Leeville Project is located in census tract 9601, which is bordered on the north and east by the Elko/Eureka County line, Lander County on the west, and interstate 80 on the south. Census tract 9516.01 adjoins on the east and includes the town of Carlin. Tracts 9506 and 9507.02 are located north and northeast of tract 9601, respectively. The closest residence to the Leeville Project is located in Carlin. Because 2000 census tract data will not be available until summer 2002, 1990 data were employed in this analysis.

The 1990 census data indicate 23 percent of Tract 9516.01 is comprised of Blacks (**Table 3-29**). By comparison, less than one percent of persons in Eureka or Elko County are assigned to this group, and only seven percent of persons in the State of Nevada are assigned to this group. Further examination revealed that all of the Blacks living in the tract were males between the ages of 30 and 35, and that they were housed in "group quarters" located in Block 141a. These "group quarters" represent the Carlin Conservation Camp, a minimum-security unit of the Nevada State Prison system. Black inmates held at that camp in 1990 did not, nor do they now represent a part of the resident population of the census tract. Therefore, for the purpose of screening for environmental justice concerns, Blacks in Tract 9516.01 do not represent a minority population as defined by EPA's guidelines (1998).

Racial composition data for adjacent census tracts (9601, 9506, and 9507.02) are consistent with regional and state levels. Therefore, a minority population does not exist within these tracts.

Summary data are available for 2000. Data specific to ethnic composition in Eureka and Elko counties and in Nevada at large are contained in **Table 3-29.** Those data indicate an increase of 66 percent in the state population; 7 percent increase in Eureka County population; and a 35 percent population increase in Elko County. The relative abundance of ethnic groups within those political units does not appear to have changed substantially over the decade. As a result, trends apparent in the 1990 census tract data appear relevant within the context of the present study.

Table 3-30 contains information on the number of persons living below the poverty level as of 1990. These data indicate that within Tract 9516.01, a disproportionately high percentage of White persons lived below the poverty level. **Table 3-30** also indicates that a disproportionately high percentage of Asians in tracts 9516.01 live below the poverty level (this finding is based on a comparatively small population of persons living in that area - 4 individuals). For environmental justice screening purposes, low-income populations (Whites and Asians), as defined by EPA's guidelines (1998), exist within Tract 9516.01.

Table 3-29
1990 and 2000 Ethnic Composition of Study Area and State of Nevada Populations

	White			Black			American Indian, Eskimo, or Aleut			Asian or Pacific Islander			Other Race			
Location[1]	Qty.	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Qty	% of Total	% His-panic	Total Popu-lation
Census Tract 9601[2]	56	95%	11%	0	-	-	3	5%	0%	0	-	-	0	-	-	59
Census Tract 9506[3]	90	100%	0%	0	-	-	0	-	-	0	-	-	0	-	-	90
Census Tract 9507.02[4]	955	86%	10%	0	-	-	9	0.8%	0%	32	3%	0%	117	11%	100%	1,113
Census Tract 9516.01[5]	163	70%	4%	54	23%	0%	2	1%	0%	4	2%	100%	9	4%	100%	232
Eureka County 1990	1,467	95%	6%	4	0.3%	0%	32	2%	6%	6	0.4%	0%	38	2%	100%	1,547
Elko County 1990	29,004	87%	8%	280	0.8%	2%	2,014	6%	8%	307	0.9%	1%	1,923	6%	98%	33,528
State of Nevada 1990	1.012,890	84%	7%	78,310	7%	2%	20,398	2%	11%	38,053	3%	3%	52,182	4%	98%	1,201,833
Eureka County 2000[6]	1,531	93%	-	9	0.5%	-	68	4%	-	15	0.9%	-	86	5%	-	1,651
Elko County 2000[6]	38,298	85%	-	362	0.8%	-	2,847	6%	-	554	1%	-	4,552	10%	-	45,291
State of Nevada 2000[6]	1,565,866	78%	-	150,508	8%	-	42,222	2%	-	128,690	6%	-	193,720	10%	-	1,998,257

1. United States Department of Commerce, Bureau of the Census, 1990, United States Census, Summary Tape File 3A.
2. Census Tract 9601 includes Eureka County north of I-80.
3. Census Tract 9506 includes part of Elko County north of the Project area.
4. Census Tract 9507, Block Group 2 includes part of Elko County northeast of the Project area.
5. Census Tract 9516, Block Group 1 includes a part of Elko County east of the Project area and north of I-80.
6. United States Department of Commerce, Bureau of the Census, Tape DP-1, Profile of General Demographic Characteristics, 2000.

Source: United States Department of Commerce 1990, 2000.

Table 3-30
Persons Below Poverty Level by Race in the Study Area Compared with the State of Nevada (1989)

	White		Black		American Indian, Eskimo, or Aleut		Asian or Pacific Islander		Other Race		Total Population	
Location[1]	Number Below Poverty Level[2]	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Race	Number Below Poverty Level	% Total Pop.
Census Tract 9601[3]	3	5%	0		0		0		0		3	5%
Census Tract 9506[4]	0		0		0		0		0		0	
Census Tract 9507.02[5]	23	2%	0		0		0		0		23	2%
Census Tract 9516.01[6]	62	38%	0		0		4	100%	3	33%	69	30%
Eureka County	142	10%	2	50%	5	16%	0		8	215	157	15%
Elko County	1,963	7%	14	5%	614	30%	26	8%	472	25%	3,089	9%
State of Nevada	83,235	8%	17,262	22%	4,766	23%	3,843	10%	10,554	20%	119,660	10%

1. United States Department of Commerce, Bureau of the Census, 1990 United States Census, Summary Tape File 3A and 3C1 unless otherwise noted.
2. The average poverty threshold for a family of four persons was $12,674 in 1989. The poverty threshold is not adjusted for regional, state, or local variations in the cost of living.
3. Census Tract 9601 includes Eureka County north of I-80.
4. Census Tract 9506 includes part of Elko County north of the Project area.
5. Census Tract 9507, Block Group 2 includes part of Elko County northeast of the Project area.
6. Census Tract 9516, Block Group 1 includes a part of Elko County east of the Project area and north of I-80.

Source: United States Department of Commerce 1990.

CHAPTER 4

CONSEQUENCES OF THE PROPOSED ACTION AND ALTERNATIVES

INTRODUCTION

Potential direct, indirect, and cumulative impacts of the Proposed Action and Alternatives are described in this chapter. Construction, operation, and reclamation of the Leeville Project and alternatives identified in Chapter 2 would result in irreversible and irretrievable commitments of resources, residual adverse effects, and cumulative impacts to the environment. Irreversible commitments of resources are those that cannot be reversed, except over a very long period of time. Irretrievable commitments of resources are those that are lost. Residual adverse effects are those effects that remain after completion of the Proposed Action and implementation of mitigation measures. Cumulative impacts are those impacts on the environment that result from incremental impact of the action when added to other past, present and reasonably foreseeable future actions.

BLM has analyzed potential impacts that could result from the Proposed Action and the following alternatives:

- No Action Alternative;
- Alternative A – Eliminate Canal Portion of Water Discharge Pipeline System;
- Alternative B – Backfill Shafts; and,
- Alternative C – Relocate Waste Rock Disposal Facility and Refractory Ore Stockpile.

Potential mitigation measures address the Proposed Action and Alternatives and have been identified in each resource description contained in this chapter for which a potential impact is described. Mitigation measures proposed by Newmont are summarized in Chapter 2. Impacts associated with implementation of these mitigation measures are included in the analysis of impacts described in this section. Additional mitigation and monitoring measures can be required by BLM as a condition or stipulation of approval for authorization of the Plan of Operations.

CUMULATIVE IMPACTS

Cumulative impact as stated in 40 CFR 1508.7 "… is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency [Federal or non-Federal] or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time . . .."

Results of cumulative impact analyses determine whether an action contributes significantly to impacts associated with other activities in the area, or results in significant impacts when added to other activities. Cumulative impact analyses do not consider potential mitigation for reasonable foreseeable actions.

The geographic cumulative impact area referred to in this section varies depending on the resource being discussed. **Figure 4-1** depicts the general area for most resources for which cumulative impacts have been evaluated. The Carlin Trend, an area of intense mine development, is the central feature of the cumulative impacts area. The area is generally bounded on the northwest by the Ivanhoe Mine and on the southeast by the Emigrant Mine.

Mine development in the Carlin Trend has principally affected distribution and occurrence of groundwater and surface water in the cumulative impacts area. In addition to the

Leeville Project, other mine activities may be proposed in the area. Potential cumulative impacts that may occur from mine dewatering and water management activities in the Humboldt River basin were analyzed separately in the report, *Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project* (BLM 2000a). That document was used as a foundation for the cumulative impacts analyses presented herein.

Cumulative impact analysis included in this section is based on an 18-year life-of-mine for the Leeville Project. Cumulative or additive impacts will therefore be described for reasonably foreseeable activities through 2020.

Past and Present Activities

Mining and livestock grazing have been and continue to be dominant land use activities on private and public land in the cumulative impacts area. Ranching activities include development of springs and groundwater resources for livestock watering, fencing, installation of windmills, development of irrigated pasture, and diversion of groundwater and surface water for irrigation. Livestock grazing has been excluded from most mining areas.

Mining activities in the cumulative impacts area include exploration (drilling, trenching, sampling), development of underground mines, open-pit mining, waste rock disposal, ore milling and processing, tailing disposal, heap leaching, dewatering/discharging, and reclamation. Historic mining activity is discussed in Chapter 2.

New or upgraded power lines have been constructed in the cumulative impacts area to supply energy for mining activities. Access roads constructed along power line corridors facilitate inspection and construction.

Reasonably Foreseeable Activities

Reasonably foreseeable activities within the cumulative impacts area include mine development, mineral exploration, mined-land reclamation, livestock grazing, wildlife habitat restoration, transmission line and substation construction, and aquatic habitat restoration. These land uses are expected to continue into the future at varying levels of activity.

Mining Activities

Mining is expected to continue as a major activity in the Carlin Trend. **Figure 4-1** shows locations of existing and reasonably foreseeable mining and exploration sites in the Carlin Trend.

The boundaries shown on **Figure 4-1** for the mining operations delineate areas where disturbance has occurred or is expected to occur. These boundaries represent the outer limits of major surface disturbance but do not imply that all the area within the boundaries would be disturbed. Acreage for existing and reasonably foreseeable mining disturbances are listed on **Table 4-1**.

Disturbances related to mine development include mine pits, processing facilities, heap leach pads, waste rock disposal facilities, tailing impoundments, haul roads, and administrative offices. Exploration on undisturbed land is not necessarily included within boundaries shown on **Figure 4-1**. Acreages of open-pit disturbance not scheduled for reclamation are listed in **Table 4-2**.

Existing mines are shown on **Figure 4-1** and details regarding these mines are presented in **Table 4-1** and **Table 4-2**. The Goldstrike Property is currently undergoing environmental review for dewatering and water management operations. The Goldstrike Property consists of the Betze/Post open pit mine and the Meikle underground mine. Exploration projects anticipated to be developed as mining projects in the near future are shown on **Figure 4-1**.

The largest mine dewatering program in the North Operations Area occurs at the Goldstrike Property where current dewatering rate is approximately 40,000 gpm, but varies seasonally. Dewatering is expected to continue at decreasing rates until year 2011 (**Figure 3-7**). Water from the Goldstrike Property dewatering system is pumped to Boulder Valley where it is infiltrated, injected, and/or used for irrigation. A large portion of water that infiltrates into the basin from the TS Ranch Reservoir reappears as three spring complexes approximately 5 miles south of the reservoir.

Figure 4-1
Cumulative Effects Area and Mining Activity in the Carlin Trend

Old Figure No. 4-4

blank

TABLE 4-1
Existing and Reasonably Foreseeable Mining Disturbance in the Carlin Trend

Map Ref. No.	Facility Name	Existing[1] and Reasonably Foreseeable Mining Disturbance (Acres)				Comments and Source of Acreage Information
		Pre-1981	1981-1999	2000-2020	Total	
1	Newmont/Great Basin Gold, Inc. - Hollister/Ivanhoe Mine	0	268	0	268	Mine currently undergoing closure and reclamation. POO-N16-87-002P/Ivanhoe underground is foreseeable action.
2	Baroid - Rossi Mine	100	183	280	563	Active barite mine, currently under exploration for gold. POO-N16-81-003P. Mine expansion is foreseeable action.
3	Glamis Gold Ltd. - Dee Gold Mine	0	802	18	820	POO-N16-83-005P. Mine currently undergoing closure & reclamation
4	Newmont – Bootstrap Project	234	0	1,056	1,290	Active gold mine. POO-N16-94-002P
5	Homestake Mining Co. – Ren Mine	0	62	0	62	Inactive mine and heap leach facility; closure and reclamation in progress. POO-N16-88-005P.
6A	Barrick – Betze/Post Mine	0	6,758	2,615	9,373	Active gold mine with dewatering. POO-N16-88-002P.
6B	Barrick - TS Ranch Reservoir	0	495	0	495	Reservoir for discharged mine water from Betze/Post Mine. POO-N16-88-002P.
7	Barrick – Meikle Mine	0	92	0	92	Underground gold mine with dewatering. POO-N16-92-002P
8	Newmont – Post/Mill #4 & Tailing Impoundment #1	0	884	0	884	Existing mill and tailing facility. POO-N16-88-008P
9	Newmont- Blue Star/Genesis Mine, Sec. 36 Project (North Star, Bobcat, Payraise, Sold and Beast Pits), & Deep Star underground mine	200	1,290	1,022	2,512	Active gold mines. POO-N16-88-007P
10	Newmont – North Area Leach Facility	0	494	169	663	Existing leach pad facility. POO-N16-88-007P.
11	Newmont-Mill#4 Tailing Impoundment #2	0	280	15	295	Existing tailing facility. POO-N16-88-008P
12	Newmont – Bullion Monarch Mine (formerly Universal Gas)	50	0	0	50	Inactive mine, mill and tailing facility; closure and reclamation in progress. Notice N16-81-013N
13	Newmont – Carlin Mine/Mill #1 and Underground Mine	0	1,598	0	1,598	Active gold mine. Expansion (Pete Project) permitting in progress. POO-N16-81-010P
14A	Newmont – South Operations Area Project (SOAP)	0	7,960	1,320	9,280	Active gold mine. Expansion permitting in progress. POO-N16-81-009P
14B	Newmont – Maggie Creek Ranch Reservoir	0	300	0	300	Reservoir for discharged mine water from Gold Quarry Mine. POO-N16-81-009P.
14C	North Area Haul Road	0	189	0	189	North-South haul road. POO-N16-81-009P.
15A	Newmont - Rain and SMZ Mine/Mill #3 and Underground Mine	0	954	7	961	Active gold mine. POO-N16-86-007P. Expansion permitting in progress (Emigrant Project).
15B	Newmont - Emigrant Mine	0	0	418	418	Proposed open-pit gold mine; permitting in progress. Expansion of Rain Mine Project. POO-N16-86-007P.
17	North Area Bioleach Facility	0	0	600[2]	600	Foreseeable gold leach operation (Newmont).
23	Meridian Gold-Rossi (Storm) Deposit	0	0	100[2]	100[2]	Foreseeable underground mine.
24	Newmont – Leeville	0	0	486	486	Proposed underground mine and facilities. POO-N16-97-004P
25	Newmont – Lantern Mine	0	235	394[2]	629	Open pit gold mine and foreseeable expansion. POO-N16-88-007P
26	Newmont - Pete Project	0	0	863	863	Proposed open pit gold mine and leach operation. Expansion of Carlin Mine. POO-N16-81-010P
28	Barrick-Rodeo/Goldbug Underground Exploration Shaft	0	0	50	50	Underground mine.
35	Great Basin Gold-Underground Mine	0	0	100[2]	100[2]	Foreseeable underground mine.
36	Newmont-Chukar Footwall Underground Project	0	0	0	0	Foreseeable underground mine.
	Total Disturbance Acres	**584**	**22,844**	**9,513**	**32,941**	

1. Projects permitted by BLM as of 2/4/00
2. Acreages for reasonably foreseeable disturbances (1998-2020) are estimates subject to change upon submittal of the actual proposal.

Note: Exploration projects shown in **Figure 4-1** total 1,124 acres; Newmont Chevas (POO-N16-93-002P) = 168 acres; Newmont Mike (POO-N16-92-004P) = 48 acres; Newmont High Desert (POO-N16-92-003P) = 164 acres; Newmont Emigrant (POO-N16-93-001P) = 63 acres; Barrick Meridan JV Rossi (POO-N16-90-002P) = 51 acres; Newmont Woodruf Creek (POO-N16-96-002P) = 66 acres; Cameco (US) REN (POO-N16-97-003P) = 30 acres; Newmont Carlin (POO-N16-81-002P) = 255 acres; Great Basin Gold Ivanhoe (POO-N16-93-003P) = 15 acres; Barrick Dee (POO-N16-98-001P) = 21 acres; Barrick Goldstrike (POO-N16-98-002P) = 233 acres; Barrick Storm Decline (POO-N16-99-001P) = 10 acres.

TABLE 4-2
Existing and Reasonably Foreseeable Mining Disturbance in the Carlin Trend from Open-Pits Only

Map Reference Number	Facility Name	Existing[1] and Reasonably Foreseeable Mining Disturbance for Open-Pits Only (Acres)				Comments and Source of Acreage Information
		Pre-1981	1981-1999	1999-2020	Total	
1	Newmont/Great Basin Gold, Inc. - Hollister Mine	0	54	0	54	Open pit gold mine currently undergoing closure and reclamation. POO-N16-87-002P.
2	Baroid - Rossi Mine	0	80	100[2]	180	Active barite mine, currently under exploration for gold. POO-N16-81-003P. Expansion of open pit is a foreseeable future action.
3	Glamis Gold Ltd. – Dee Gold Mine	0	136	248	384	Active gold mine. POO-N16-83-005P.
4	Newmont – Bootstrap Project	59	0	155	214	Active gold mine. POO-N16-94-002P. Capstone Pit has been backfilled (approximately 10 acres).
5	Homestake – Ren Mine	0	5	0	5	Inactive mine and heap leach facility; closure and reclamation in progress. POO-N16-88-005P
6A	Barrick – Betze/Post Mine	0	1,412	0	1,412	Active gold mine with dewatering. POO-N16-88-002P
9	Newmont - Blue Star/Genesis Mine and Section 36 Project (North Star, Bobcat, Payraise, Sold and Beast Pits)	50	506	420	976	Active open-pit and underground gold mines. POO-N16-88-007P
12	Newmont – Bullion Monarch Mine (formerly Universal Gas)	6	0	0	6	Inactive open pit mine, mill and tailing facility; closure and reclamation in progress. Notice N16-81-013N
13	Newmont – Carlin Mine	100	226	0	326	Active gold mine. POO-N16-81-010P
14A	Newmont- South Operations Area Project (SOAP)	0	815	1,158	1,973	Active gold mine with dewatering. POO-N16-81-009P
15A	Newmont - Rain and SMZ Mine	0	165	7	172	Active gold mine. POO-N16-86-007P
15B	Newmont - Emigrant Project	0	0	123	123	Proposed open pit gold mine. Permitting in progress; POO-N16-87-006P
25	Newmont – Lantern	0	53	47[2]	100	Active open pit gold mine and foreseeable mine expansion. POO-N16-88-007P
26	Newmont - Pete Mine	0	0	487	487	Proposed open pit gold mine; Permitting in progress. POO-N16-81-010P
Total Disturbance Acres From Open Pits Only		215	3,452	2,745	6,412	

[1] Projects permitted by BLM as of 2/4/00.
[2] Acreages for reasonably foreseeable disturbances (1998-2020) are estimates subject to change upon submittal of the actual proposal.

Dewatering activities associated with Newmont's South Operations Area Project would continue into the near future. The combined cones of depression created by Newmont's South Operations Area (i.e., Gold Quarry Mine) and Barrick's Goldstrike Property dewatering programs would continue to create additive effects in regional groundwater drawdown.

Reclamation Activities

Reclamation of mined land throughout the Carlin Trend would restore portions of the land surface and would reduce impacts created by mining, including wildlife, grazing, and visual impacts. Vegetation that resembles natural, undisturbed areas would become established and allow disturbance areas to blend with adjacent areas. Highwalls associated with open pits and cuts would continue to disrupt the natural visual elements.

GEOLOGY AND MINERALS

Summary

The Proposed Action and Alternatives would have direct impacts on geologic and mineral resources. The impacts would be limited to excavation and relocation of waste rock, processing of ore, and removal of gold. The No Action Alternative would result in the loss of an unrealized gold reserve.

Indirect impacts would involve potential discharge of acidic water from waste rock disposal facilities and sulfide-bearing ore stockpiles. Static geochemical acid-base accounting (ABA) test results indicate that a small percentage of ore and waste rock that would be generated under the Proposed Action is potentially acid-generating (PAG). Meteoric Water Mobility Procedure (MWMP) tests indicate that waste rock and refractory ore have potential for leaching some metals. However, Newmont has developed a program for hydrologic PAG isolation and encapsulation. This approach would minimize acid generation and leachate migration in stockpiles to prevent adverse environmental effects resulting from stockpiling mine rock. Newmont has also proposed reclamation methods for waste rock facilities to prevent post-mining acid generation within the stockpiles.

The proposed Plan of Operations states mine stopes would be backfilled with neutral or acid-neutralizing aggregate cement. This procedure should prevent future acid generation from exposed PAG rock within the underground workings.

Proposed acid generation and leachate migration control measures include construction of refractory ore stockpiles and waste rock dumps on low permeability bases, encapsulation of PAG waste rock, and inspection and monitoring programs. These measures are expected to adequately mitigate potential impacts of stockpiling ore and disposing waste rock under the Proposed Action and Alternatives. These measures are described in greater detail in the Waste Rock Disposal Facilities section of Chapter 2. Potential instability of disposal and storage facilities would be mitigated through proper design and construction.

Direct and Indirect Impacts

Proposed Action

Geologic and mineral resources within the area affected by the proposed Leeville Project would be directly impacted by relocation of approximately 4 million tons of waste rock and 14 million tons of ore. The Proposed Action would create indirect impacts by placing potentially acid- generating (PAG) rock in waste rock disposal areas and by exposing sulfide material in the refractory ore stockpile to oxygen. Rain and snowmelt infiltrating through waste rock and ore piles could potentially cause an acidic water discharge containing elevated concentrations of some metals.

Under the Proposed Action, a refractory ore stockpile and waste rock facility would be constructed in Section 10, T35N, R50E (**Figure 2-4**). Ore would be transported directly to processing facilities or refractory ore stockpiles. All waste rock would be transported to the waste rock facility. The proposed Plan of Operations states most of the mined out stopes would be backfilled with cemented rock fill.

Tonnage of waste rock to be extracted under the Proposed Action has been estimated for the life of the project according to rock type (Coxon 1997). Total waste rock tonnage and tonnage-weighted acid-base accounting (ABA) values are listed in **Table 4-3**. PAG rock has a neutralization potential ratio (NPR) of less than the BLM Standard 3:1 and the NDEP Standard 1.2:1 (BLM 1996b). These data indicate that approximately 75 percent of the estimated 4 million tons of waste rock would be West Leeville lower plate unoxidized carbonate, which is non-PAG rock. The remaining 25 percent consists of a mix of West Leeville, Four Corners, and Turf deposits, the majority of which is also non-PAG. The Four Corners waste rock is PAG, and constitutes approximately 5 percent of the total tonnage. The West Leeville upper plate carbon sulfide refractory waste rock is potentially PAG and constitutes approximately 2.5 percent of the total tonnage.

TABLE 4-3
Waste Rock Tonnage Estimates and Tonnage-Weighted ABA Values
(ABA Data from Laboratory Analyses)
Leeville Mine Project

Waste Rock				Waste Tonnage		ABA Values			
Deposit	Domain	Formation	Lithology	Tonnage	Fraction of Tonnage	NNP	NPR	Tonnage Weighted NNP	Tonnage Weighted NPR
West Leeville(WLW1)	UP	Ovi	UC	21,920	0.006	106	4.1	0.6	0.0
West Leeville(WLW2)	UP	Ovi	CSR	102,476	0.026	10.2	1.3	0.3	0.0
West Leeville(WLW3)	LP	Unk	UC	2,912,483	0.737	152	15.7	112.1	11.6
Four Corners(FCW1)	LP	Unk	CSR	210,295	0.053	-27.1	0.4	-1.4	0.0
Turf(TW1)	UP	Drc	CSR	15,207	0.004	9.5	1.4	0.04	0.006
Turf(TW2)	LP	Dp	UC	124,122	0.031	104	3.2	3.3	0.1
Turf(TW3)	LP	SDrm HW	UC	40,552	0.010	171	6.5	1.8	0.1
Turf(TW5)	LP	SDrm FW	Unk	370,585	0.094	137	6.3	12.9	0.6
Turf(TW6)	LP	SDrm	UC	152,755	0.039	315	26.2	12.2	1.0
Total				**3,950,395**	**1.000**			**141.6**	**13.3**

Note: NA = Data not available; ABA = acid-base accounting; NNP = net neutralization potential; NPR = neutralization potential ratio; WLW = West Leeville Waste; FCW = Four Corners Waste; TW = Turf Waste; UP = Upper Plate; LP = Lower Plate; Unk = Unknown; Ovi = Vinini Formation; Drc = Rodeo Creek Formation (Turf Deposit); Dp = Popovich Formation; SDrm = Roberts Mountains Formation; HW = Hanging Wall; FW = Footwall; UC = unoxidized carbonate; CSR = carbon sulfide refractory.
The equation used to calculate weighted average is: y = (0.006 x WLW1) + (0.026 X WLW2) + (0.737 x WLW3) + (0.053 x FCW1) + (0.004 x TW1) + 0.031 x TW2) + (0.010 x TW3) + (0.094 x TW5) + 0.039 x TW6).
Source: Coxon 1997

A small amount of upper plate Turf waste rock is PAG and would only be mined to develop a ventilation shaft proposed as a contingency.

Data in **Table 4-3** collectively indicate the total mass of waste rock would be non-PAG with a net neutralization potential (NNP) of 141 and a NPR value of 13. Waste rock volume is estimated at 3.9 million tons (Newmont 1997a). Operational sampling during development and exploration would be used to monitor waste rock geochemistry.

Table 4-4 summarizes average metal mobility values, calculated for the MWMP results using the tonnage presented in **Table 4-3**. These results indicate that seepage from waste rock would exceed water quality standards for antimony (Sb), arsenic (As), manganese (Mn), nickel (Ni), selenium (Se), sulfate and total dissolved solids (TDS).

Newmont has developed guidelines for storage and disposal of PAG waste rock and ore and rock material that have potential to release metals (Newmont 1997a). The objective of the guidelines is to minimize potential for acid drainage by controlling the acid generation process. Control measures for waste rock and stockpiled ore include: 1) placing PAG rock on a base constructed of compacted low permeability materials designed to minimize leaching to groundwater; 2) segregating and/or mixing PAG rock; 3) encapsulating PAG rock within acid-neutralizing rock (NNP greater than + 40); 4) sloping and wheel compacting lift surfaces; 5) controlling surface water to minimize infiltration; 6) encapsulating and capping PAG rock during reclamation; and 7) reclaiming the waste rock disposal facility. The ore stockpile is temporary and, therefore, would not be capped and reclaimed.

ABA data indicate the total mass of waste rock to be generated over the Project life would be non-PAG. However, of this total mass, concentrated volumes of PAG rock would be produced at specific points in the mining sequence. An estimated 210,295 tons of Four Corners waste rock that is PAG would be generated between 2003 and 2010, and another 102,476 tons of West Leeville waste rock that is PAG would be generated in 2002 and 2003. MWMP analyses indicate the three deposit types have potential to leach certain metals. PAG waste would be encapsulated with rock with a high net neutralization potential (NNP) in order to neutralize acid generated by the waste rock. The waste rock facilities would be constructed on a low permeability base to inhibit leaching of metals into groundwater. At closure, the waste rock facilities would be capped by a 24 inch base of topsoil or other suitable growth medium and revegetated to minimize potential infiltration.

TABLE 4-4
Average Metal Mobility Values for Waste Rock
Leeville Mine Project

	Nevada Water Standards (mg/L)	MWMP Results From Weighted Average ROM Waste Rock (mg/L)
Metals		
Antimony (Sb)	0.146	1.195
Arsenic (As)	0.05	0.15
Barium (Ba)	2.0	0.02
Beryllium (Be)	0.004*	0.001
Cadmium (Cd)	0.005	0.003
Chromium (Cr)	0.1	0.006
Copper (Cu)	1.3*	0.004
Iron (Fe)	0.3* (s)	0.04
Lead (Pb)	0.05	0.0025
Manganese (Mn)	0.05* (s)	0.17
Mercury (Hg)	0.002	0.0002
Nickel (Ni)	0.0134	0.3626
Selenium (Se)	0.05	0.08
Silver (Ag)	—	0.008
Thallium (Tl)	0.013	0.009
Zinc (Zn)	5.0* (s)	0.27
Non-metals		
Chloride (Cl)	250	6.8
Fluoride (Fl)	4.0*	0.5
Nitrate (NO_3)	10	0.09
Cyanide (CN)	0.2	0.01
Sulfate (SO_4)	250	832
Total Dissolved Solids (TDS)	500	1417
pH	5.0-9.0	--

Notes:
Nevada water quality standards are the "Municipal or Domestic Supply" values listed on **Table 3-13**; if no corresponding state standard exists, the federal drinking water standard is used and denoted by an asterisk (*). Values with (s) are secondary drinking water standard.
MWMP = meteoric water mobility procedure; ROM = run-of-mine; mg/L = milligrams per liter

Source: Coxon 1997

According to the proposed Plan of Operations, most mined out stopes would be backfilled with cemented rock fill (Newmont 1997a). Access levels, excavations for underground facilities, and shafts would not be backfilled. The backfill would consist of neutral or acid-neutralizing material from existing open pit operations in the area or Project waste rock.

Methods of post-mining waste rock facility reclamation have been proposed by Newmont (1997a). These methods include regrading and revegetating the waste rock facility and diverting run-on surface water. These actions would stabilize the stockpiles and simultaneously limit infiltration and erosion. Quarterly inspection of refractory ore stockpiles and waste rock disposal facilities would be conducted for signs of acid rock drainage (ARD) production and to ensure integrity of the cover and surface water management systems.

Any disruption to mine facilities and workings from seismic activity would be from liquefaction or ground rupture. Liquefaction occurs when seismic shaking causes earth material to lose its inherent strength and behave like a liquid. In general, liquefaction can occur where earth material is fully saturated, loose, unconsolidated, and/or sandy. Surface or underground rupture may occur along an active fault trace during an earthquake. Underground workings are typically designed to withstand pressures exerted by the overlying mass of rock. These design criteria are typically much greater than ground shaking or acceleration stresses exerted by earthquakes.

Alternative A and/or C

Impacts on geology and mineral resources from implementation of Alternative A and/or C would be similar to those described under the Proposed Action.

Alternative B

Implementation of Alternative B (backfill shafts) would preclude the likelihood of further mining the potential geologic resource.

No Action Alternative

The No Action Alternative would avoid potential direct and indirect impacts of the Proposed Action. It would also eliminate the recovery of approximately 14,081,000 tons of ore from the geologic resource at the Leeville Project site.

Cumulative Impacts

The cumulative impacts area for geology and mineral resources depicted in **Figure 4-1** incorporates existing and reasonably foreseeable mining activity through 2020. The area included in this analysis includes the Carlin Trend and extends from the Emigrant Project in the southeast to the Hollister Mine in the northwest. Cumulative impacts of dewatering operations for the Goldstrike Property, South Operations Area Project, and Leeville Project were evaluated in the Cumulative Impact Analysis report (BLM 2000a).

The primary issue identified by BLM (2000a) for assessment of cumulative impacts to geology and minerals is the potential for development of sinkholes or other karst-type collapse features that could result from mine induced groundwater drawdown or other water management activities.

The BLM (2000a) stated that sinkholes develop in areas where: 1) mine dewatering is predicted to lower the water table or increase infiltration; or, 2) areas with soluble carbonate rocks at or near the ground surface. In order for sinkholes to be propagated to the surface, limestone would need to occur at depths less than 50 to 100 feet, and water levels would need to be greater than about 300 feet. Limestone in the Leeville Project area occurs at about 800 feet below ground surface and the depth to water is about 1,000 feet (**Figure 3-11**). Therefore, the proposed Leeville Project mine site is in an area unlikely to be impacted by sinkhole development (BLM 2000a).

Areas that are susceptible to karst development are located within the groundwater drawdown cone of depression created by mine dewatering systems in the Carlin Trend (**Figure 4-4**). The potential that a sinkhole would develop at any given location in the Carlin Trend depends on specific site conditions including depth to carbonate rocks, mineralogy of the carbonate rock, hydrostratigraphy of the rock, size of voids in the rock, characteristics of overlying materials, and the site specific effects of cumulative mine dewatering on groundwater at the site (BLM 2000a).

Because gold mining is a major activity in the Carlin Trend, it is reasonable to assume that large-scale mining would continue and result in creation of open pits, underground mines, waste rock disposal areas, heap leach pads, milling and tailing storage facilities, and administrative offices. Future exploration may also result in delineation of deeper oxide and refractory ore zones that would require dewatering systems for economical recovery of ore. It is not possible to quantify the total volume of ore, waste materials, and gold that could be economically excavated from the Carlin Trend in the future.

Topography of the area would continue to be modified as a result of mine excavation, waste rock and tailing disposal, and reclamation. Continued mining may afford the opportunity to backfill mined-out pits with waste rock from future operations. Such opportunities would be judged individually and based upon accessibility as well as influence on future mining activities. Backfilling and subsequent reclamation would restore land to pre-mining uses.

Potential Mitigation and Monitoring Measures

At closure, Newmont would develop a plan to provide long-term monitoring for acid generation associated with the Waste Rock Disposal Facility. Newmont would be required to monitor for waste rock seepage for a period of 30 years after reclamation is completed at the Leeville Project site. This time period for monitoring would be reviewed periodically by the agencies to determine whether modifications to the monitoring program are warranted.

If sinkholes form in karst-prone areas and their formation is attributable to the Leeville Project, Newmont would be required to backfill the sinkhole(s) and restore the land surface. No other mitigation or monitoring measures beyond those described in the Plan of Operations have been identified.

Newmont would modify their encapsulation procedure to incorporate limestone as the material to form the base, sides, and top of the PAG rock encapsulation disposal facility. Use of limestone would provide positive acid neutralizing potential to the acidic leachate that could form in the waste rock disposal facility.

Irreversible and Irretrievable Commitment of Resources

Approximately 14,081,000 tons of ore would be removed from the geologic resource at the Leeville Mine if the Proposed Action is implemented. This action would constitute an irreversible commitment of the geologic resource.

Residual Adverse Effects and Impacts of Mitigation

No residual adverse effects to the geologic resource would be expected from the Proposed Action and mitigation measures.

PALEONTOLOGICAL RESOURCES

Summary

Physical disturbance associated with the Leeville Project could result in limited impacts to paleontological resources. If vertebrate fossils are discovered during mine development or operational activities, Newmont would cease mining in the vicinity of the fossil discovery, and contact BLM to determine steps necessary to evaluate the discovery. Potential impacts for Alternative A and/or B would be similar to the Proposed Action. Impacts would be limited to areas of land disturbance. Potential impacts that would result from Alternative C would be less because fewer acres of land would be disturbed.

Direct and Indirect Impacts

Proposed Action

Paleontological resources in the Leeville Project study area could consist of vertebrate, invertebrate, and paleobotanical fossils. Vertebrate fossils are more likely found in Tertiary- and Quaternary-age sediments, whereas invertebrate fossils are more common in Paleozoic-age strata. Known fossils in the study area have a relatively broad regional distribution, and are not restricted to the study area or north-central Nevada. No known fossil quarries or vertebrate fossils are located in the area to be physically disturbed by the proposed Leeville Mine. Impacts on any fossils that may exist in the proposed disturbed area would usually be direct, caused by physical disturbance.

Alternatives A and B

Impacts on paleontological resources under Alternatives A and/or B would be similar to those described under the Proposed Action.

Alternative C

Impacts on paleontological resources resulting from implementation of Alternative C would be reduced commensurate with 118 acres less new surface disturbance.

No Action Alternative

The No Action Alternative would avoid potential direct and indirect impacts of the Proposed Action and other action alternative to paleontological resources.

Cumulative Impacts

The cumulative impact area for paleontological resources includes areas potentially disturbed by mining activities through 2020. Vertebrate fossils occur primarily in Tertiary- and Quaternary-age sediments and invertebrate fossils are more common in Paleozoic-age sedimentary rocks. Because of the greater abundance of vertebrate fossils, mining activity that intercepts Tertiary-age sediments would have the greatest potential for impacting paleontological resources. Other mining-related excavations (e.g., leach pads, waste rock disposal areas) are shallow and would primarily affect unconsolidated soil surfaces. While the cumulative impact of mining in the Carlin Trend may result in loss or destruction of fossils, this region of Nevada is not known for significant paleontological resources.

Potential Mitigation and Monitoring Measures

If vertebrate fossils are discovered during project construction or operation the following mitigation measures would be implemented:

- Newmont would suspend operations in the immediate vicinity of the discovery;
- BLM would be notified within 24 hours of the discovery;
- Newmont would take necessary measures to protect the resource until an evaluation has been completed by BLM; and
- BLM would define an appropriate level of treatment if the discovery is determined significant.

Irreversible and Irretrievable Commitment of Resources

Irreversible and irretrievable commitment of paleontological resources could occur as a result of the Proposed Action if fossils are encountered in the disturbance areas.

Residual Adverse Effects and Impacts of Mitigation

Minimal residual adverse effects on paleontological resources are possible, but not likely, as a result of the Proposed Action or mitigation measures. Some paleontological resources could be damaged or partially destroyed during mine development if they are not discovered prior to disturbance. Implementation of mitigation measures would however, result in protection or documentation of paleontological resources that would otherwise be lost. It is believed by some specialists in the field of paleontology that even if discovered, removal and recovery of fossils only provides a partial mitigation of the potential resource lost.

AIR QUALITY

Summary

Mining-related activities at the Leeville Project would be a source of particulate and gaseous air pollutants. Fugitive dust emissions would be generated by mining, processing, hauling, storing ore, and disposal of waste rock. Particulate emissions would be mitigated by dust suppression and Best Management Practices (BMPs) as outlined in the Handbook of Best Management Practices (Nevada State Conservation Commission 1994). Gaseous pollutant emissions would result from blasting, construction and mining equipment, and vehicle exhaust. These emissions would be minimized by proper equipment maintenance and operation. Newmont would seek any required air quality construction and operating permits from the Nevada Division of Environmental Protection (NDEP), Bureau of Air Quality.

Implementation of Alternative A and/or C would result in the same amount and type of air contaminant emissions as the Proposed Action. Alternative B would require approximately 1500 truck-loads of waste rock to be hauled to the production and ventilation shafts resulting in additional gaseous emissions from vehicles and fugitive dust from loading and hauling. Leeville Project emissions would not affect air quality or visibility in any Class I areas.

Direct and Indirect Impacts

Proposed Action

Gaseous and particulate air contaminant emissions would be generated during construction and continue throughout the mining period. Construction of surface facilities, including the pipeline route, would generate fugitive dust from excavation, earth moving, and vehicle traffic. Underground mining, crushing, and ore-handling activities would create fugitive dust.

Diesel engine exhaust from construction equipment, underground mining equipment, and various transportation vehicles would generate gaseous air pollutants. Emissions from underground operations would be ventilated through four ventilation shafts.

Particulate Emissions

Mining would occur underground with fugitive dust emissions controlled at the point of generation. Rock would be extracted using conventional drill and blast techniques. Some rock might be excavated using a mechanical miner. Drilling would be completed using jackleg drills, jumbos, or bench drills. All drilling activities would be performed "wet" to minimize airborne dust. After blasting, muck piles would be wetted to reduce dust. Water sprays would be installed at the grizzly to minimize dust from rock handling.

From the grizzly, ore would be conveyed to ore bins. Skips would be used to hoist ore and waste rock to the surface where it would be dumped into a head frame bin. The rock would be transferred from the bin via conveyors to surface stockpiles. Fugitive particulate emissions from material handling and storage above ground would be concentrated around storage piles.

Leeville Project plans include backfill plants that would consist of backfill stockpiles, conveyors, and cement silos. Fugitive dust emissions would be generated from wind erosion of disturbed areas and road dust. All haul roads would be maintained on a continuous basis for safe and efficient haulage and to minimize fugitive dust emissions. Generation of fugitive dust from ore handling, crushing, and grinding activities would be controlled using Best Management Practices (Nevada State Conservation Commission 1994) which could include direct water application, use of approved chemical binders or wetting agents, water spray, baghouses, and revegetation of disturbed areas concurrent with operations.

Gaseous Emissions

The Leeville operations would be a source of gaseous air pollutants including sulfur dioxide (SO_2), carbon monoxide (CO), oxides of nitrogen (NOx), and volatile organic compounds (VOCs). The primary source of these emissions would be exhaust from diesel engines used to power construction equipment, mining machines, and haul trucks. Gaseous emissions from diesel engines would be minimized through proper operation and maintenance.

Another source of gaseous pollutants in the Leeville mining operations would be from ammonium nitrate and fuel oil (ANFO) used as blasting agents. The use of ANFO can cause fugitive emissions of NOx, CO, and SO_2. Emissions from ANFO would be reduced by restricting use to underground operations where emission would be controlled.

Electrical power would be provided by an existing transmission line. A large diesel electrical generator would be installed for emergency evacuation and ventilation in the event of a power failure.

Mercury Emissions

Ore from the Leeville Project would be processed at Newmont's South Operations Area processing facility. Carbon handling and refinery services at the South Operations Area facility create mercury emissions. Diesel and gas combustion sources also emit mercury.

As described in the Proposed Action in Chapter 2, Newmont would transport all ore generated from Leeville operations to the South Operations Area for processing. Newmont has developed a detailed air toxics inventory for the South Operations Area facility using stack test results, emissions factors, actual processing rates, and hours of operation to determine actual mercury emissions for 1998 and 1999. Based on Newmont's Toxic Release Inventory (TRI), total air borne emissions of mercury from the South Operations Area processing facility were 82 pounds in 1998 and 90 pounds in 1999.

Maximum potential hourly emissions would not increase due to processing of the Leeville ore at the South Operations Area. Leeville ore would offset production from existing sources with no projected increases in total annual mercury emissions from the South Operations Area.

Mercury is included on the federal list of hazardous air pollutants, which has been adopted by reference in the Nevada air quality regulations. Nevada air quality regulations (NAC445B.349) prohibit the "*discharge into the atmosphere from any stationary source of any hazardous air pollutant or toxic regulated air pollutant that threatens the health and safety of the general public, as determined by the director.*"

The EPA has not established a National Emission Standard for Hazardous Air Pollutants (NESHAPs) for mercury emissions from gold ore processing facilities. Mercury is not considered a primary pollutant and no national or Nevada ambient air quality standard (NAAQS) have been established under the Clean Air Act.

In November 2000, the Nevada Division of Environmental Protection (NDEP) published a report entitled "*Mercury Emissions from Major Mining Operations in Nevada*." The NDEP report concludes that, based upon review of available information, "there is currently no imminent and substantial public health threat associated with mercury emissions in the region. NDEP will continue its current mercury monitoring efforts and will track monitoring efforts of other agencies." The report also states that there is "insufficient data to determine whether the mercury measured in the environment of the region results from natural or anthropogenic sources."

Alternatives A and C

Implementation of Alternative A and/or C would result in similar impacts to air quality as those described for the Proposed Action.

Alternative B

Alternative B would require approximately 1500 truck loads of waste rock to be hauled to the production and ventilation shafts resulting in additional gaseous emission from vehicles and fugitive dust from loading and hauling.

No Action Alternative

The No Action Alternative would eliminate potential impacts of the Proposed Action on air quality.

Cumulative Impacts

Fugitive dust and gaseous emissions from nearby mine operations affect air quality in the Project area. The Leeville Project would create continued and extended haul truck traffic on the North Area Haul Road as well as extended operation of milling facilities at the South Operations Area. Ambient air quality data for the region currently reflects impacts of existing mining operations in the airshed. Air quality in the region meets applicable standards and would be expected to remain in compliance with addition of Leeville operations. Approximately 2,000 lbs. of mercury and mercury compounds was reported released annually to air by mining operations in the Carlin Trend (NDEP 2000).

Potential Mitigation and Monitoring Measures

Air quality emission sources at the Leeville Project would be subject to requirements of federal and Nevada air quality regulations. NDEP Bureau of Air Quality would determine whether air quality construction and operating permits would be required for the Project. The air quality permitting process could require that Newmont submit a permit application, including a complete inventory of potential criteria air pollutant emissions from the Project.

Industrial air quality permitting is part of the Nevada State Implementation Plan (SIP) process. The NDEP Bureau of Air Quality uses air quality permit conditions to help ensure compliance with applicable Nevada regulations and National Ambient Air Quality Standards (NAAQS), and Prevention of Significant Deterioration (PSD) increments. The area surrounding the Leeville site is a designated Class II area as defined by the federal PSD program (see Chapter 3, *Air Quality*).

The nearest PSD Class 1 area is Jarbidge Wilderness, located approximately 75 miles northeast of the Leeville site. Fugitive particulate and gaseous emissions from the Leeville Project would not be expected to create an impact at the Jarbidge Wilderness due to the distance between the sites. The Leeville Project would not be visible from Jarbidge Wilderness and emissions from the operations would not be expected to contribute to degradation of visibility in the Class I area.

Crushing and conveying operations would be subject to emission and reporting requirements of the New Source Performance Standards for Metallic Mineral Processing Plants (NSPS subpart LL). If the backfill plants do not crush or grind aggregate or limestone, they would not be subject to NSPS Subpart OOO, Standards of Performance for Nonmetallic Mineral Processing Plants. The NDEP Bureau of Air Quality would make final NSPS applicability determinations in the air quality permitting process.

Measures to reduce particulate emissions include reducing vehicle speed, minimizing drop heights during loading, watering, chemically stabilizing haul roads, and use of water spray, water fog, or baghouse fabric filter during crushing and ore handling.

Following submittal of an air quality permit application, NDEP could require an ambient air quality monitoring program to ensure compliance with ambient air quality standards.

Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of air resources would result from the Proposed Action or Alternatives.

Residual Adverse Effects and Impacts of Mitigation

No residual adverse effects on air resources would be anticipated as a result of the Proposed Action and mitigation measures. After cessation of mining and completion of reclamation activities, air quality would be expected to approach pre-mining conditions.

WATER QUANTITY AND QUALITY

Summary

Removal of groundwater using dewatering wells would be the primary cause of water-related impacts from the Leeville Mine. Leeville dewatering would add to regional groundwater drawdown currently created by dewatering at the Goldstrike Property and Gold Quarry Mine. Maximum dewatering rate for the Leeville Mine would be approximately 25,000 gallons per minute (gpm) during the first 2 years, followed by a gradual decline to about 8,000 to 10,000 gpm once the ultimate target depth is reached. Water would be routed through a water treatment plant constructed at the Leeville site to meet specified water quality standards. This water would then be pumped by pipeline and canal to Barrick's existing water management system in the Boulder Valley, where water is distributed to the TS Ranch Reservoir, other infiltration basins, and/or irrigation systems.

Water pumped from dewatering wells for the mine would increase the depth of groundwater lowering in a portion of the existing cone of depression in the Leeville Project area. This additional drawdown zone would be located within the areal extent of current and future groundwater drawdown resulting from other mines' dewatering systems in the Carlin Trend. A total of about 360,000 acre-feet of water would be removed by Leeville dewatering wells during the life-of-mine.

Discharge of excess water from the Leeville Mine dewatering system would be transported to infiltration basins (including TS Ranch Reservoir) and irrigation systems (seasonally). If these systems cannot handle all of Leeville's excess water during the first few years when dewatering rates are highest, Newmont would try to find other options of disposing water in the Boulder Valley before seeking approval from the State Engineer to discharge some water to the Humboldt River in Barrick's existing conveyance system. Approximately 212,000 acre-feet of water would be infiltrated into the Boulder Valley using the water management system over the life of the Leeville Project. Adverse impacts to surface water quality are not expected from mine dewatering at Leeville, other than minor additional chemical loading, because water would be treated prior to discharge to Boulder Valley. Minor increases in sedimentation would occur during construction activities.

Adverse impacts to groundwater quality from the Proposed Action are expected to be limited to minor short-term increases in some constituents (e.g., nitrate and some metals) immediately surrounding underground workings as the water table rises during recovery of the cone of depression. Most underground workings would be backfilled with cemented rock aggregate consisting of neutral or acid-neutralizing material.

Impacts to groundwater rights associated with the Leeville Project would include additional lowering of water levels for a limited number of wells. Adverse impacts to surface water rights are not expected to occur from the Proposed Action.

Dewatering at Leeville would extend the period of recovery to within 90 percent of the original water table by about 20 years after cessation of mining. This would affect recovery of water levels in impacted wells and recovery of reduced flow in impacted streams and springs/seeps. On a cumulative basis, reductions in baseflow resulting from the Leeville Project are predicted to be 0.1 cfs or less for each of the potentially affected streams (e.g., Maggie, Boulder, Beaver, and Marys creeks) and the Humboldt River.

Alternative A would eliminate water flowing in about one mile of open canal between the Leeville Mine and TS Ranch Reservoir. Complete backfill of the shafts (Alternative B) may cause minor short-term increases in some chemical constituents in groundwater within and surrounding the backfilled mine workings. Alternative C would result in a smaller disturbance area which would reduce the amount of sedimentation during construction activities on previously undisturbed land.

Direct and Indirect Impacts

Proposed Action

Primary impacts on water resources from the Leeville underground mine would be associated with the dewatering system. As described in the *Water Quantity and Quality* section of Chapter 3, the Leeville Mine site is located within the groundwater drawdown area created by dewatering wells associated with Barrick's nearby Betze/Post open pit mine and underground Miekle Mine (i.e., Goldstrike Property). Dewatering wells proposed for the Leeville Mine, therefore, would add to the ongoing regional lowering of the water table.

Water from the Leeville dewatering system that is not consumed for mine-related activities would be added to Barrick's water management system for the Goldstrike Property. Water in this system is discharged primarily to infiltration basins, including the TS Ranch Reservoir, which are located in the upper, northern part of the Boulder Valley (**Figure 3-5**). During the irrigation season, most excess mine water is used for flood and sprinkler irrigation in the Boulder Valley. Total irrigation acreage is in excess of 10,000 acres. Injection wells are also available near the infiltration basins, but typically are not used due to scaling problems in the wells. Also, water injected in the wells recharges the same aquifer as the infiltration basins, which are lower maintenance; therefore, there is little incentive to use the injection wells.

Barrick's conveyance system to the Humboldt River consists of 7 miles of buried pipeline, 13 miles of lined canal, and a discharge structure at the Humboldt River. Newmont does not propose to discharge excess mine water to the Humboldt River. If the existing system of infiltration and irrigation in the Boulder Valley cannot effectively handle the volume of excess water from Leeville operations, Newmont would identify other locations within the Boulder Valley that may be suitable for infiltration and irrigation. If these locations cannot be established, Newmont would seek authorization from the State Engineer (per Ruling 5011) to use Barrick's conveyance system to an outfall at the Humboldt River.

Transportation and use of Hazardous Materials in the Project area could potentially impact surface and groundwater quality. Additional truck traffic servicing the Leeville Project may result in an increase of rollover accidents in Maggie Creek Canyon. Currently, nearly one truck accident per year results in fuel and/or cargo being spilled into or near Maggie Creek.

Impacts to surface and groundwater would vary depending on location and substance(s) released/spilled. Newmont has implemented an Emergency Response Plan (Newmont 1995b) and Spill Prevention, Control, and Countermeasure (SPCC) plan (Newmont 1995a) to address accidental spills or releases of Hazardous Materials. Accidental spills or releases due to malfunctioning components would be contained and remediated in accordance with these plans and applicable state and federal regulations.

Numerical Modeling

Hydrologic Consultants, Inc. (HCI), as a consultant to Newmont, used its numerical groundwater flow model of the Carlin Trend to predict groundwater inflow to the proposed Leeville underground mine and associated impacts that would occur to water resources from the Leeville dewatering system (HCI 1999a). Potential effects on water resources from all current and proposed dewatering operations along the northern Carlin Trend also are addressed by HCI (1999b) and in the Cumulative Impact Analysis report (BLM 2000a). A detailed summary of the Carlin Trend model is contained in the cumulative report (BLM 2000a). A summary of the numerical groundwater flow model for the Leeville Project is included as **Appendix B**.

In order to separate potential impacts to water resources associated with the proposed Leeville Mine from impacts associated with all other Carlin Trend area dewatering, HCI (1999b, 1999d) simulated regional dewatering with and without the Leeville Project. By comparing two modeled drawdown areas, it is possible to determine where groundwater drawdown has increased due to the projected Leeville dewatering system. The area of drawdown in the water table aquifer that would be caused by dewatering at the Leeville Mine only is shown on **Figure 4-2**. The cumulative change in lateral extent of predicted maximum drawdown areas in the water table aquifer is shown on **Figure 4-3**. These groundwater drawdown impacts are discussed later in this section (see *Impacts to Groundwater Levels and Storage* and *Cumulative Impacts*).

Impacts to Surface Water Quantity

The maximum groundwater pumping rate for Leeville is expected to be approximately 25,000 gpm for the first 2 years during the sinking of ventilation and production shafts. This rate would gradually decline to a range of about 8,000 to 10,000 gpm once the ultimate mining depth is reached (**Figure 3-7**). If water from the dewater-ing system is discharged directly to the Humboldt River (see **Figure 4-3** for discharge point) during non-irrigation season, flow in the river would increase downstream. Maximum flow to the river, if any, could be about 24,000 gpm (500 to 1,000 gpm would be consumed for mine operations), however, Newmont would continue disposal of excess water through infiltration and irrigation. Newmont estimates that discharge to the Humboldt River, if necessary, would not likely exceed 10,000 gpm (Pettit 2001). This additional flow is within the rate approved for Barrick's NPDES permit (69,000 gpm) associated with the Goldstrike Property. Barrick has not discharged water under this permit since February 1999, and has no plans to do so at present.

Changes in flow at several locations along the Humboldt River were evaluated for the dewatering period associated with the Leeville Project using discharge from the Goldstrike Property, Gold Quarry, and Leeville mines for low, average, and high water years (BLM 2000a). As Barrick does with its Goldstrike Property dewatering system, Newmont would retain all excess Leeville Mine water in the Boulder Valley using the TS Ranch Reservoir, irrigation, infiltration basins, and possibly injection wells.

Since the Humboldt River is over-appropriated, additional mine water in the river, if approved by the State Engineer, would be a benefit to water right holders in the basin. Most seasonal discharge to the river would occur during the time when flow is generally low; therefore, no impacts to channel geometry are expected and aquatic habitat could be improved. Additional details on potential impacts to the Humboldt River can be found in the Cumulative Impact Analysis report (BLM 2000a) and Betze Project Draft Supplemental EIS (BLM 2000b).

The additional volume of groundwater removed by Leeville dewatering would extend the recovery time for streams that would have reduced flows after cessation of mining in the Carlin Trend. Streams within the direct impact area shown on **Figure 4-2** include Rodeo, Welches, and Sheep creeks (tributaries of Boulder Creek), middle Maggie Creek (in the Narrows), upper Simon, Lynn, James, Soap, and Cottonwood creeks (tributaries of Maggie Creek), and Marys Creek (tributary to Humboldt River). Most of these streams have perennial reaches interspersed with intermittent or ephemeral reaches. At higher elevations (i.e., above 6000 feet in elevation) the two primary sources of water are direct run-off from precipitation that falls in the mountains and a shallow perched groundwater system. At lower elevations the regional water table supplies the baseflow. Only that portion of baseflow supplied by the regional groundwater system could be affected by dewatering.

As described in the Betze Project Draft Supplemental EIS (BLM 2000b), unless impacts have already occurred to these streams from mine dewatering (i.e., possibly some seasonal affects on Rodeo Creek), the streams likely are not connected to the regional groundwater system and, therefore, would not be directly or indirectly affected by Leeville dewatering. Portions of streams in the drawdown area shown on **Figure 4-2** that have perennial flow below elevation 6000 feet probably are supplied by water sources above 6000 feet.

Using the Carlin Trend model (HCI 1999a), effects on stream flow from Leeville dewatering were predicted for Marys Creek, Maggie Creek, Boulder Creek, and Humboldt River. Effects on flow in these water bodies caused by Leeville are discussed in the *Cumulative Impacts* section for *Water Quantity and Quality*. Recovery to within 90 percent of the premining water table would take up to 20 more years due to Leeville dewatering, depending on the location within the cone of depression.

Impacts to Surface Water Quality

Excess mine water from Leeville's dewatering system would be transported via pipeline and canal to Barrick's Boulder Valley water management system. None of this water is expected to be discharged to streams or rivers. During the irrigation season, most of the water would be included in the Boulder Valley sprinkler and flood irrigation system. During the non-irrigation season, Leeville's excess mine water would be infiltrated at the TS Ranch Reservoir and other infiltration basins. Newmont's contingency for unexpected excess water from Leeville that cannot be used for irrigation and/or infiltration is to discharge to the Humboldt River using Barrick's existing pipeline and ditch system to a permitted outfall at the river (see outfall on **Figure 4-3**). In order for Newmont to use this outfall, however, it must receive prior authorization from the State Engineer (per Ruling 5011). **Table 3-11** includes information on rates and volumes of potential discharges to the Humboldt River for the Leeville Mine, Gold Quarry Mine, and Goldstrike Property.

For the proposed Leeville Mine, quality of water from the dewatering system was calculated using laboratory analyses of samples collected from two dewatering wells completed in lower plate rock at the Leeville Mine site (**Table 4-5**). Chemical concentrations from the wells were weighted to reflect the estimated percent contribution of groundwater from each identified hydrogeologic zone. The calculated average concentrations were then assumed to approximate the average concentrations in mine water from the Leeville dewatering system.

Results of groundwater mixing presented in **Table 4-5** show that arsenic (0.134 mg/L) in discharge water would not meet the drinking water standard of 0.05 mg/L; however, water would meet the aquatic life standards for arsenic of 0.18 mg/L (96-hour average) and 0.342 mg/L (1-hour average) Cadmium in the mixed groundwater would not meet one of the aquatic life standards of 0.0013 mg/L (based on water hardness of 150 mg/L).

Other parameters shown in **Table 4-5** with corresponding water quality standards would meet the standards for both drinking water and aquatic life. Temperature of groundwater

Figure 4-2

blank

Figure 4-3

blank

pumped in the Leeville Mine area ranges from 67 to 87ºF. Any parameters that do not meet regulatory standards would be treated at the Leeville Mine, resulting in concentrations that would not adversely impact water resources and would meet NPDES permit limits.

Water that is treated and pumped from the Leeville dewatering system to TS Ranch Reservoir and other infiltration basins in Boulder Valley would temporarily be retained as surface water in impoundments; however, this water and some irrigation water would readily infiltrate to the groundwater system. Therefore, no impacts to surface water quality would occur. If all excess mine water from Leeville cannot be distributed via irrigation, infiltration, and/or injection, then some water may be discharged to the Humboldt River after approval from the State Engineer. Impacts that have occurred or could occur from discharge to the river have been evaluated in the Cumulative Impact Analysis report (BLM 2000a) and the Betze Project Draft Supplemental EIS (BLM 2000b). If water from Leeville is discharged to the Humboldt River, potential impacts would be similar to or less than those described in the two documents listed above.

All disturbed areas associated with the Leeville Project (e.g., refractory ore stockpile; waste rock facility; and production shaft area; **Figure 2-4**) would have surface water run-off and run-on control ditches. The system of run-off control ditches would collect surface water from disturbed areas, and run-on ditches would prevent water from undisturbed areas flowing over any disturbance. Run-off water would be collected in sediment ponds and used for dust suppression.

Minor increases in sediment may occur to upper Rodeo Creek during construction of road crossings. As stated in the *Water Quantity and Quality* section of Chapter 3, elevated concentrations of arsenic are present in Rodeo Creek. The Leeville Project is not expected to increase concentrations of arsenic or other constituents in Rodeo, Boulder, and Sheep creeks, or their tributaries because of best management practices (BMPs) that would be implemented for disturbed areas. Newmont (1995c; 1997a) would obtain a stormwater permit and utilize BMPs during construction and reclamation activities to prevent sediment input to the drainage channels. BMPs are defined by the Nevada State Conservation Commission (1994) and would include silt fences, straw bale dikes, temporary diversions, sediment basins, and other measures that would minimize exposure of disturbed materials to stormwater.

An erosion stability analysis was performed for the Leeville Project to estimate sediment yield for the post-mining landscape (Newmont 1997a). Reclamation measures used to reduce erosion would include revegetation of disturbed areas and regrading waste rock and surface facility areas. Results of sediment loss calculations using the Revised Universal Soil Loss Equation (RUSLE) show pre-mine erosion rates are up to 6.08 tons/ acre/year, and post-mine rates would be up to 2.53 tons/acre/year (Newmont 1997a). Refer to the *Soils* section in this chapter for more information regarding erosion potential.

Impacts to Springs and Seeps

Individual springs and seeps identified in the project area are shown on **Figure 4-2** in relation to additional groundwater drawdown area predicted for the Leeville Project. Approximately 40 springs/ seeps are located within the predicted drawdown area. However, groundwater drawdown predicted for Leeville as shown on **Figure 4-2** would occur within the cumulative cone of depression as shown on **Figure 4-3**. The springs/seeps either have already been impacted by regional mine dewatering or have not been impacted because they are associated with the shallow, perched water table system. Some springs flow only intermittently from seasonal precipitation events. Four springs located within the Leeville Project area boundary (**Figure 4-2**) would not be subject to surface disturbance by mine-related activities.

The additional volume of groundwater removed by Leeville dewatering may increase the recovery period by about 20 years after cessation of dewatering for springs/seeps that are affected by the cone of depression. During the dewatering period at Leeville, the additional water added to the TS Ranch Reservoir would allow Green, Knob, and Sand Dune springs to continue flowing.

Impacts to Groundwater Levels and Storage

The Carlin Trend model (HCI 1999a) was used to predict the magnitude and extent of groundwater drawdown over time resulting from dewatering at major mines located in the Carlin Trend (BLM 2000a). Groundwater drawdown currently totals over 1,500 feet in the Goldstrike Property area, and over 600 feet in the Gold Quarry Mine area.

Lowest water table elevation expected as a result of dewatering at Leeville Mine would be approximately 3,800 feet in the lower plate hydro-stratigraphic unit (i.e., carbonate rocks). Current groundwater elevations in the lower plate are approximately 4,800 feet in the Leeville area (**Figure 3-13** and **Table 3-17**). Therefore, this water level would be lowered an additional 1,000 feet immediately surrounding the underground workings. Dewatering at the Goldstrike Property and Gold Quarry Mine has already lowered water levels in the upper and lower plates in the Leeville area by 265 and 369 feet, respectively (HCI 1999b, **Table 3-17**).

TABLE 4-5
Representative Groundwater Quality for Dewatering at Leeville Project

Parameter[1]	Well HDDW-1A[3]	Well HDDW-2[3]	Combined Wells[4]	Aquatic Life Standards[5]	Nevada Standards for Municipal or Domestic Supply[6]
Number of Samples	4	4	8	---	---
Pumping Rate (gpm)[2]	18,000	2,000	20,000	---	---
Est. % of Total Water	90%	10%	100%	---	---
Hydrostratigraphic Unit	Lower Plate	Lower Plate	---	---	---
TDS[2]	305	321	307	---	500 - [1000]
pH (std units)	8.09 – 8.17	8.08 – 8.16	---	6.5 – 9.0	5.0 – 9.0
Temperature (°F)	86 – 87	67 – 70	---	ss[5]	---
Alkalinity (as HCO_3)	170	185	172	---	---
Calcium (Ca)	42.2	51.9	43.2	---	---
Sodium (Na)	10	13.1	10.3	---	---
Magnesium (Mg)	19.5	20.2	19.6	---	---
Potassium (K)	3.0	4.0	3.1	---	---
Chloride (Cl)	7.7	12.5	8.2	---	250 - [400]
Fluoride (Fl)	0.33	0.84	0.38	---	---
Sulfate (SO_4)	45.5	72.2	48.2	---	250 - [500]
Nitrate (NO_3)	<0.10	<0.10	<0.10	90 / 90	10
Antimony (Sb)	0.007	0.030	0.009	---	0.146
Arsenic (As)	0.068	0.726	0.134	0.342 / 0.18	0.05
Boron (B)	<0.10	<0.10	<0.10	---	---
Cadmium (Cd)	<0.005	0.009	0.003*	0.0053 / 0.0013	0.005
Chromium (Cr)	<0.05	<0.05	<0.05	0.015 / 0.01	0.10
Iron (Fe)	0.32	0.39	0.33	1.0 / 1.0	0.3 - [0.6] (s)
Manganese (Mn)	0.01	0.08	0.02	---	0.05 - [0.1] (s)
Mercury (Hg)	<0.001	<0.001	<0.001	0.002 / 0.000012	0.002
Selenium (Se)	0.005	0.004	0.005	0.02 / 0.005	0.05
Zinc (Zn)	0.01	0.06	0.02	0.14 / 0.127	5.0 (s)

1 All units in milligrams per liter (mg/L) unless otherwise specified. Metals are dissolved concentrations.
2 TDS = total dissolved solids; gpm = gallons per minute.
3 Samples were collected during the period of April 1996 – August 1997; values on table are the highest concentrations measured (see **Table 3-18** for range, mean, and standard deviation values).
4 Results of groundwater mixing are based on 90% from well HDDW-1A and 10% from well HDDW-2 as recommended by Paul Pettit of Newmont (personal communication); the value with an asterisk (*) for cadmium indicates that the less than value of <0.005 mg/L was set at half the value for calculating a resultant concentration.
5 See **Table 3-13** for listing of aquatic life standards; first value is the 1-hour average standard (propagation) and the second value is the 96-hour average standard (put and take). ss = site-specific determination for water temperature.
6 See **Table 3-13** for listing of water quality standards; numbers in brackets [ ] are mandatory secondary standards for public water systems; (s) indicates federal secondary drinking water standard.

Source: Newmont 1997b.

Results of numerical groundwater flow modeling described earlier in this section are presented on **Figures 4-2** and **4-3**. Area of potential concern with respect to declining water levels is the area predicted to have a change in elevation of 10 feet or more from mine dewatering. Changes in groundwater elevation of less than 10 feet are not considered adverse impacts because these changes are on the order of natural seasonal and annual fluctuations in groundwater levels. Drawdown results shown on **Figure 4-3** are cumulative from all Carlin Trend mine dewatering and, therefore, are discussed later in the *Cumulative Impacts* section.

Figure 4-2 shows contours that depict additional vertical drawdown that would occur in the water table aquifer (primarily lower plate rocks) from Leeville Mine dewatering. The model predictions show the maximum extent of the 10-foot contour for additional drawdown that would be caused only by Leeville. This additional drawdown area is oriented primarily north-south along the hydrographic basin boundary between the Boulder Flat and Maggie Creek Area (**Figure 4-2**). Lateral dimensions of the area affected by 10 feet or more of drawdown due to Leeville dewatering are approximately 19 miles by 9 miles. For the area predicted to have more than 100 feet of drawdown, dimensions are approximately 11 miles by 4 miles (**Figure 4-2**).

The upper plate rocks (siltstone) at Leeville are generally not in direct hydraulic contact with the underlying lower plate rocks (carbonate). Most dewatering volume from Leeville would occur from lower plate rocks; therefore, drawdown in upper plate rocks would be limited. Lower plate rocks are exposed at the surface west and south of the Leeville site however, the plates are not differentiated on **Figure 4-2**. Additional groundwater drawdown as a result of Leeville pumping would be greater than 100 feet in that area (i.e., lower plate rocks).

A total of approximately 360,000 acre-feet of groundwater would be pumped during the proposed mining period for the Leeville Project. This would reduce the amount of groundwater present in the Boulder Flat and Maggie Creek hydrographic basins; these are the areas primarily affected by dewatering at Leeville (**Figure 4-2**). Some of the removed groundwater would be replaced by groundwater inflow from surrounding areas. In addition, a majority of the removed water would be returned to the Boulder Flat hydrographic basin using irrigation, infiltration basins (including TS Ranch Reservoir), and possibly injection wells. Of the water applied to irrigation, about 30 percent of the volume is assumed to reach the groundwater system.

Total volume of water predicted to be pumped from dewatering systems at Goldstrike Property and Gold Quarry Mine is 1,085,000 and 595,000 acre-feet, respectively (BLM 2000a). Therefore, Leeville dewatering (360,000 acre-feet) would represent about 18 percent of the total water volume to be pumped from the three Carlin Trend mines. According to Maurer et al. (1996),the Boulder Flat hydrographic area receives about 14,000 acre-feet per year of natural recharge. Total reinfiltration volume of excess Leeville Mine water would be about 212,000 acre-feet for the life-of-mine (BLM 2000a).

Assuming an 18-year mine life for Leeville, an average water volume of 20,000 acre-feet per year (12,400 gpm or 28 cfs) would be removed using dewatering wells, and 11,800 acre-feet per year would be infiltrated back into Boulder Valley, assuming a 30 percent return of irrigation water to the groundwater system (**Table 3-11**). Therefore, average net groundwater loss due to Leeville dewatering would be 8,200 acre-feet per year (5,000 gpm), or 40 percent of total water withdrawal, for the 18-year mine life. This water loss would be a result of consumption from mining-related activities, evapotranspiration, and discharge to the Humboldt River (if necessary). During the first 2 years of dewatering at Leeville, pumping rates are predicted to be double the average annual values presented above (also see **Figure 3-7**).

After cessation of mining and dewatering in the Carlin Trend, the groundwater drawdown area would begin to recover to premine conditions. The additional water removed by the Leeville Project is expected to extend recovery time by 1 to 20 years, depending on location in the cone of depression. This results in Leeville adding 4 to 6 percent to the total recovery period for Carlin Trend dewatering. Based on results of the groundwater flow model, recovery of the lower plate water level would begin in about 2020 and continue for more than 100 years (HCI 2000). Recovery of groundwater in the upper plate would begin earlier because dewatering of the upper plate at Leeville would terminate approximately 4 years after initiation of mining and dewatering.

Some areas of Boulder Valley west and south-west of the Leeville Mine have experienced increasing water levels in shallow hydrostratigraphic units (i.e., alluvium and Carlin Formation) due to infiltration of excess water from the Goldstrike Property in the vicinity of the TS Ranch Reservoir and irrigation systems. By the end of 1998, water levels in shallow bedrock and alluvium in the Boulder Valley had risen up to about 50 feet (Barrick 1999). This mounding of groundwater in Boulder Valley, if significant, may result in some limitations on infiltrating excess mine water in the TS Ranch Reservoir area.

As discussed in the *Geology and Minerals* section of this chapter, some areas in the vicinity of the Leeville site are potentially susceptible to sinkhole development in limestone. These areas in relation to projected drawdown contours caused by Leeville dewatering, are shown on **Figure 4-4**. Due to the significant depth to groundwater in this area already caused by regional mine dewatering, the additional drawdown caused by Leeville is not expected to cause development of sinkholes.

Impacts to Groundwater Quality

Mining and milling activities associated with the Leeville Project are not expected to impact groundwater quality beyond what may occur from current mine and processing operations in the area. Processing of ore from the Leeville Mine would occur at a currently permitted facility in the South Operations Area. This facility is designed to protect and monitor groundwater quality to prevent adverse effects (e.g., low permeability liner and monitoring wells). For potential impacts to water resources from the proposed refractory ore stockpile and waste rock facility at the Leeville site (e.g., acid rock drainage and leaching of metals), refer to the *Geology and Minerals* section in this chapter. During reclamation, the final waste rock facility would be regraded and vegetated to inhibit erosion, collection of surface water, and infiltration. No ore stockpiles would remain after reclamation. The septic drainfield to be constructed at Leeville is expected to operate properly and not impact water quality.

Minor short-term impacts to groundwater quality immediately surrounding the Leeville underground mine workings may occur as the water table rises (e.g., elevated nitrate from blasting residue). The lack of oxygen in the flooded underground mine, in addition to the removal of a significant amount of acid rock drainage producing material during mining, would inhibit development of acidic water conditions and associated leaching of metals. Most of the mined stopes would be backfilled with cemented rock fill consisting of neutral or acid-neutralizing material. Tests of waste rock to be generated at Leeville indicate the total mass of rock would be non-acid-generating; however, local zones of acid-generating waste material would be mined and encapsulated.

Meteoric water mobility tests show that some chemical constituents may be elevated (see *Geology and Minerals* section in this chapter).

During advancement of the mine shafts within the first few years of Leeville operation, dewatering in the upper plate would prevent mixing of water in the lower plate. When the upper plate dewatering wells are turned off, concrete lining along the shaft wall is expected to prevent water inflow and mixing of upper and lower plate water zones. Pressure grouting methods may be used, if necessary, to control areas of discreet inflow.

Water quality characteristics are similar between the upper and lower plate hydrostratigraphic units (**Table 3-18**) and, therefore, if mixing did occur, it would not result in adverse quality impacts. Once the water level in the shafts reaches the contact between the upper and lower plates after termination of dewatering, the potential for water mixing is diminished. This may take 100 years or more of recovery, however.

Impacts to Water Rights

Impacts to individual water rights would depend on site-specific hydrologic conditions. For Leeville, additional groundwater drawdown would occur within the cone of depression that will continue to develop from dewatering at the Goldstrike Property and Gold Quarry Mine (**Figures 4-2 and 4-3**). **Table 4-6** lists groundwater rights located within the drawdown area that are shown on **Figure 4-2** for the direct impact area. Water rights are not required for most domestic wells. However, there are no known domestic wells in the Leeville Project area.

Impacts to groundwater rights resulting from Leeville dewatering could cause additional water table lowering in three stock-watering wells and two mining/milling wells (**Table 4-6**). Several other groundwater rights applied for by Elko County are in the Gold Quarry Mine area and would be affected primarily by dewatering at this mine. Specific impacts to individual wells would depend on factors associated with well completion, including well depth, pump setting, water yield, and cumulative effects from dewatering at other mines in the area.

Figure 4-4

blank

TABLE 4-6
Water Rights Located Within Predicted Groundwater Drawdown Area

Map Location Number for Diversion Site[1]	Application/Permit Number and Status[2]	Owner of Record	Use	Comments[3]
Groundwater Rights				
39 – 46	57020 – 57027; RFP	Elko County	Recreation	10 – 100 ft added drawdown
64	28197; CER	Polar Resources Co.	Mining & Milling	10 – 100 ft added drawdown
65	30615; CER	Polar Resources Co.	Mining & Milling	>100 ft added drawdown
135	23881; CER	Newmont Gold Co.	Stock	10 – 100 ft added drawdown
143	28969; CER	Elko Land & Livestock	Stock	10 – 100 ft added drawdown
167	46044; CER	Elko Land & Livestock	Stock	10 – 100 ft added drawdown
Surface Water Rights				
85	45509; CER	Newmont Gold Co.	Stock	In Maggie Creek Basin
118	3474; CER	Charles Drake	Irrigation	In Maggie Creek Basin
38 – 39	3146 – 3147; CER	Almond Fox	Irrigation	In Boulder Valley just outside drawdown area

[1] See **Figure 4-2** for water right diversion sites.
[2] RFP = ready for action (protested); CER = certificate.
[3] For groundwater rights, comments indicate predicted additional groundwater drawdown that may occur in wells due to Leeville Mine dewatering.

Source: BLM 2000a

Adverse impacts to surface water rights could occur when dewatering at Leeville adds to ongoing decreases in surface water flow in the area as a result of Leeville contribution to the cone of depression. Surface water rights in the Leeville drawdown area are listed in **Table 4-6** and shown on **Figure 4-2**. One irrigation and one stock surface water right are located in the Gold Quarry Mine area. Two irrigation surface water rights are located along Boulder Creek about 3 miles downstream from the predicted drawdown area. Since drawdown has already occurred in the area shown on **Figure 4-2** from regional mine dewatering, additional drawdown caused by Leeville would have no direct or indirect effect on surface water rights except to lengthen the period of recovery by about 20 years. Additional surface water rights in the Leeville Project area are associated with the TS Ranch Reservoir which is currently supplied with water from Goldstrike Property dewatering systems.

Alternative A

Replacement of about 1 mile of lined open canal with a pipeline under Alternative A would eliminate approximately 5 gpm loss due to evaporation from the open canal.

Alternative B

Backfilling the production and ventilation shafts would be completed using approximately 166,000 cubic yards of waste rock from the Leeville Mine. As described in the *Geology and Minerals* section in this chapter, most waste rock from the Leeville Mine would not be potentially acid-generating (non-PAG). Backfill material, however, would have potential to leach some metals and adversely impact groundwater quality around the shafts on a short-term basis. Based on meteoric water mobility tests conducted on representative waste rock samples from Leeville, the following constituents could be elevated in water around backfilled waste rock: antimony, arsenic, manganese, nickel, selenium, and sulfate (see **Table 4-4**). Adverse impacts to groundwater quality surrounding Leeville Mine workings, however, should be negligible because (1) shaft would be lined with cement, and (2) background water quality (**Table 3-18**) surrounding the Leeville ore body has elevated concentrations of similar constituents.

Alternative C

This alternative would result in 118 acres less new disturbance which could reduce the amount of sedimentation during construction activities on undisturbed land.

No Action Alternative

The No Action Alternative would eliminate water-related impacts that would be attributed solely to the Leeville Project. Many of the impacts occurring in this area (e.g., groundwater drawdown and discharge of excess mine water), however, would continue as a result of disturbance and dewatering associated with other mines in the Carlin Trend.

Cumulative Impacts

Cumulative impacts area for water resources includes the following hydrographic areas: Boulder Flat (No. 61); Maggie Creek Area (No. 51); Rock Creek Valley (No. 62); Willow Creek Valley (No. 63); Susie Creek Area (No. 50); Marys Creek Area (No. 52); and Humboldt River from Carlin Tunnels gage to Humboldt Sink. BLM's Cumulative Impact Analysis report (BLM 2000a) contains a comprehensive analysis of impacts resulting from dewatering operations at Leeville Mine, Goldstrike Property, and Gold Quarry (i.e., South Operations Area) Mine. The latter two mines have ongoing dewatering operations that have resulted in a cone of depression in the Carlin Trend bedrock groundwater system. Also included in the Cumulative Impact Analysis report (BLM 2000a) is an analysis of impacts to Humboldt River flow from combined mine discharges and groundwater drawdown.

Continued dewatering at the Goldstrike Property and future expansions of Gold Quarry Mine, as well as the proposed Leeville Mine, would result in expansion of the groundwater drawdown area until after dewatering ceases. Infiltration of excess mine water in Boulder Valley from ponds and irrigation has resulted in an increase in groundwater levels in those areas. This situation also occurs to a lesser degree in Maggie Creek Valley from seepage at Maggie Creek Reservoir and along portions of lower Maggie Creek.

Continued groundwater drawdown in the Carlin Trend could adversely impact regional water levels in neighboring water wells and flow from spring and seeps. However, significant effects on monitored springs have not been observed to date. Most springs above 6000 feet occur from perched, shallow groundwater systems higher in the mountains not connected to deeper, regional groundwater systems affected by dewatering.

The predicted maximum extent of groundwater drawdown (based on 10-foot drawdown contour from the Carlin Trend model) in the Carlin Trend north of the Humboldt River is shown on **Figure 4-3**. This figure shows the drawdown area in the water table for two scenarios: (1) all Carlin Trend mine dewatering, including Leeville; and (2) Carlin Trend dewatering without Leeville. Comparing the two drawdown areas on **Figure 4-3**, shows that the Leeville Mine would expand the maximum drawdown area to a relatively small degree in three areas: central Boulder Flat, Maggie Creek Basin along a portion of Beaver Creek, and along the drainage divide between Maggie Creek and Susie Creek.

Using the Carlin Trend model, HCI (1999a) predicted the effects of Leeville dewatering on the baseflow of several streams, including Marys, Maggie, and Boulder creeks, and the Humboldt River. Baseflow conditions are assumed to occur around October when most flow in the drainage is attributable to groundwater discharge (i.e., precipitation and evapo-transpiration are at a minimum). Baseflow in all reaches of the Humboldt River in the study area, and in Maggie, Marys, and Boulder creeks is predicted to decrease by less than 0.1 cfs in each water body due to Leeville dewatering.

The cumulative flow reduction that may be caused by Leeville dewatering is predicted to be 0.1 cfs or less for Marys, Boulder, Maggie, and the Humboldt River. A reduction of 0.1 cfs in upper Maggie Creek is approximately 2.7 percent of the mean October baseflow of 3.7 cfs in the creek (USGS 2000). For all combined mine dewatering in the Carlin Trend, predicted maximum reductions in flow for streams potentially affected by Leeville dewatering on a cumulative basis would be: Humboldt River = 8 cfs; Boulder Creek = 0.1 cfs; upper Maggie Creek = 0.8 cfs; and Marys Creek = 1.9 cfs (BLM 2000a).

Maximum reductions in stream flow are predicted to occur approximately 10 years after cessation of dewatering, after which base flow conditions would begin to approach premine flows. On a cumulative basis, over 100 years will be required to achieve premine flow rates (BLM 2000a). Flows are predicted to gradually return to approximately 99 percent of historic annual volumes by year 2095 (BLM 2000a).

Of three areas that are predicted to have increased groundwater drawdown outside the drawdown areas for the Goldstrike Property and Gold Quarry Mine (**Figure 4-3**), only one area would potentially affect streamflow – the middle section of Beaver Creek. There are no flow data for Beaver Creek; however, measurements for nearby Coyote, Spring, Jack, and Little Jack creeks show streamflow typically is in the range of 0.1 to 10 cfs in the upper reaches (Newmont 2001). Springs and seeps in the mountains maintain year-round flow in these stream sections. The lower reaches of these streams in the Maggie Creek valley bottom typically become dry after the spring run-off period.

Based on Carlin Trend model results, maximum impacts to baseflow in Beaver Creek, where the cone of depression would cross the stream (**Figure 4-3**), would be 0.05 cfs (HCI 2001). At higher elevations the two primary sources of water to mountainside streams such as Beaver Creek are direct run-off from precipitation that falls in the mountains and a shallow perched groundwater system. At lower elevations, the regional water table supplies the baseflow. Only that portion of baseflow supplied by the regional groundwater system could be reduced by 0.05 cfs.

Potential cumulative impacts to the Humboldt River from all mine discharges in the Carlin Trend and farther downstream have been evaluated in detail in BLM's Cumulative Impact Analysis report (BLM 2000a), Draft Supplemental EIS for the Betze Project (BLM 2000b), and Draft EIS for the South Operations Area Project Amendment (BLM 2000c).

Discharges from dewatering systems at Gold Quarry, Goldstrike, and Lone Tree Mines, to the Humboldt River have increased over time since the early 1990s to as much as 100,000 gpm (BLM 2000a). Discharge rates currently vary as the mines continue their water management programs. The overall water management goal in the Humboldt River basin is to minimize discharge to the river and retain water as infiltration back to groundwater in the affected local watersheds.

Modeling of projected future mine discharges, including Leeville, show that the largest percentage of increased flow in the river would occur in the lower flow months, and relatively little change would be observed during high flow months (BLM 2000b). Historic flow data for the Humboldt River show that post-1990 flows during the mine discharge period are within the range recorded historically (1946 to 1990) prior to mine discharges (BLM 2000b).

Any increases in Humboldt River flow from mine discharges are not expected to cause additional flooding, erosion, sedimentation, and changes in channel geometry. Excess mine water to the river would contribute to the stored volume in Rye Patch Reservoir and could raise concerns during high-flow years about the ability to provide emergency storage to minimize flooding and structural damage downstream.

Water quality from mine discharges in the Humboldt River basin generally have been within permit limitations. On an average annual basis, the mine discharges represent a loading increase in several constituents, including total dissolved solids, arsenic, boron, copper, fluoride, and zinc (BLM 2000b). This load increase, which would primarily affect Rye Patch Reservoir and Humboldt Sink, would be a relatively small incremental increase of total load in the river.

In November 1993, the BLM adopted for implementation the South Operations Area Project (SOAP) Mitigation Plan (BLM 1993b). Measures included in the SOAP Mitigation Plan and subsequent revisions to the Mitigation Plan in the SOAP Amendment (BLM 2000c) address potential adverse impacts from dewatering without regard to whether they occur on public or private land. Measures in the plan that deal directly with dewatering include extensive groundwater monitoring and reporting protocols. The monitoring data are used to trigger implementation of mitigation measures found in the plan, including flow augmentation for individual springs, seeps, and streams. Additional impacts to groundwater and surface flow attributable to the Leeville Project would be offset by these mitigation activities.

Potential Mitigation and Monitoring Measures

Monitoring of water resources in the vicinity of the Leeville Project is ongoing as part of the Boulder Valley and Maggie Creek Basin monitoring plans (Barrick 2000; Newmont 2001). Numerous surface water stations located on stream channels in the area (**Figure 3-6**) are used to monitor flow rates and water quality. Newmont also monitors six Rodeo Creek stations as part of its Water Pollution Control Permit in the North Operations Area. Numerous wells completed in the Leeville Mine area (**Figures 3-11** and **3-13**) are used to monitor water level changes. Groundwater quality data would continue to be obtained from dewatering wells. Several springs also are routinely monitored by Barrick and Newmont in the Project area (**Figure 3-10**).

For all water resource monitoring in the Project area, the period of monitoring would be extended at least 18 years beyond monitoring schedules currently in-place (or proposed) for the Goldstrike Property and Gold Quarry Mine. In addition to the ongoing monitoring sites previously described in this chapter and Chapter 3 for surface water, groundwater, and springs/seeps, Newmont would develop a monitoring program specifically for its proposed waste rock dump and refractory ore stockpile. This monitoring program would include locations and schedule for water samples in the vicinity of these facilities.

In addition to wells currently monitored by Barrick and Newmont in the Project area, Newmont would periodically sample and analyze water from its dewatering wells for the Leeville Project. Other wells located near the Leeville site would be evaluated for possible monitoring.

For springs/seeps, Barrick is currently monitoring one of the four springs identified within the Leeville Project boundary (**Figure 3-10**). Newmont would develop an expanded monitoring program to include springs/seeps within and possibly near the Leeville Project boundary. Perennial springs in Beaver Creek would also be established as monitoring sites. Newmont would evaluate existing quality data for springs/seeps, and gather new data including tritium, to help determine which springs might be further affected by Leeville dewatering.

An additional surface water monitoring station on Sheep Creek downgradient of the Leeville site would be established. Newmont and BLM would evaluate the need to monitor Beaver Creek in Maggie Creek basin because of projected cumulative groundwater drawdown in that area caused by Leeville dewatering (**Figure 4-3**). Existing monitoring wells (i.e. HDP-12 and JKC-1) assess potential impacts to Beaver Creek. Other "step-out" wells may be needed to define extent of groundwater drawdown in this area. If any streamflow impacts could be attributed to Leeville, appropriate mitigation would be implemented.

Monitoring water resources, as described above, would continue until the water table has achieved 90 percent recovery or, until federal and state agencies determine it is no longer necessary. BLM would review and approve all monitoring plans for the Leeville Project and determine associated bond amounts. The monitoring program would be evaluated and revised periodically after review of water quality and quantity data, and updated numerical model results.

Mitigation measures may include additional BMPs if sedimentation from disturbed areas, and/or other surface water quality impacts become excessive in the drainages. If any water quality problems were to occur from the Leeville Project, (i.e., impacts detected at monitoring sites for surface water, groundwater, or springs/seeps), the situation would be evaluated for potential source(s) and the problem corrected. Such corrective action measures would be performed under the authority of state and federal agencies.

If mixing of upper plate and lower plate groundwater is detected in shafts or nearby monitoring wells at closure, Newmont would modify shaft backfilling operations to incorporate placement of fine-grained material across the contact zone between these two hydrostratigraphic units. Fine grained material could include cement, and/or clay to form a less permeable zone.

Irreversible and Irretrievable Commitment of Resources

Total volume of groundwater removed during life-of-mine dewatering operations at Leeville would be approximately 360,000 acre-feet. A small portion of this water would be consumed at the mine site and the remainder would be added to Barrick's existing Boulder Valley water manage-ment system. An estimated 212,000 acre-feet, or about 60 percent of the total dewatering volume, would be reinfiltrated into Boulder Valley via infiltration basins and irrigation systems. Proportions of this water that would go to various locations cannot be established at this time.

The remaining 40 percent of water volume (148,000 acre-feet) from the dewatering system that is not reinfiltrated would be consumed by mine-related activities, irrigation, evaporation (via infiltration basins), and possibly some discharge to the Humboldt River. With the exception of irrigation, this water represents a permanent removal from Boulder Flat basin, and to a lesser degree, the Maggie Creek basin.

The Proposed Action would also increase the duration of some impacts to water sources within the overall regional groundwater drawdown area. This would include recovery of groundwater levels because of additional volume of water withdrawn by Leeville dewatering. Additionally, declines in stream baseflow for Maggie, Marys, and Boulder creeks, and the Humboldt River would be extended due to Leeville dewatering.

Compared to pre-mine conditions, overall recovery of water levels and stream flows would take over 100 years. Contribution from Leeville dewatering, however, would equate to about 20 years of recovery time extension, or adding 4 to 6 percent to the total recovery period for Carlin Trend dewatering.

Residual Adverse Effects and Impacts of Mitigation

Eventual recovery of groundwater levels after dewatering ceases in the northern Carlin Trend would allow impacts to wells and streams, if any, to diminish. This recovery period is expected to be more than 100 years. No other residual adverse effects on water resources are expected from the Leeville Project. No adverse impacts associated with mitigation activities are expected for water resources.

SOILS

Summary

The proposed Leeville Project, which includes underground workings, above-ground waste rock disposal facility, ore stockpile, roads, water discharge pipeline/canal system, and other surface support facilities would result in approximately 486 acres of surface disturbance. Potential impacts on soil resources include loss of soil during salvage and replacement, soil loss in stockpile due to erosion, and reduced biological productivity. These impacts are expected to be minimized, to the extent possible, following successful reclamation of a majority of the disturbed land. Some disturbed areas, such as rock faces and capped shafts, would not be reclaimed following completion of the Leeville Project. Loss of soil and interruption of natural soil processes and functions would be reversed by natural soil development over time. Reclamation efforts would expedite soil development.

Impacts resulting from implementation of Alternative A and/or B would be similar to those described for the Proposed Action. Impacts on soil resources resulting from implementation of Alternative C would be reduced commensurate with 118 acres less new surface disturbance.

Direct and Indirect Impacts

Impacts on soil resources occur in two separate stages during mining operations: 1) soil loss during mining, when salvaged topsoil is stock-piled and stabilized in storage areas; and 2) soil loss while stockpiled and during final topsoil redistribution and completion of reclamation. Although impacts to soil are greater during mining, topsoil erosion during and after topsoil redistribution has a greater effect on final reclamation.

Proposed Action

Direct impacts on soil resources from the Proposed Action would include modification to soil chemical and physical characteristics, loss of soil to wind and water erosion, and decreased soil biological activity over a surface disturbance of 486 acres. Chemical changes would result from mixing surface soil with subsoil during salvage activities, and reduce the amount of organic matter in surface soil. Impacts on physical characteristics of soil during salvage, stockpiling, and redistribution would include soil mixing, compaction, and pulverization from equipment and traffic. Soil compaction and pulverization would result in decreased permeability and water-holding capacity, and loss of soil structure and finer-grained soil material due to erosion.

Short-term soil loss associated with the Leeville Project would be greater than normal until vegetation becomes established. Soil loss from wind erosion is potentially high in Nevada's arid, windy climate. The potential for loss of salvaged soil would be greatest during reclamation after topsoil redistribution on disturbed areas. Potential for loss of subsoil would be greatest between initial disturbance and cover soil redistribution. The volume of soil loss would depend on wind velocity, size and condition of exposed area, and soil texture.

Water erosion potential could be high during heavy precipitation due to exposed soil, fine soil texture, soil surface conditions, and slope. However, management practices, such as mulching, addition of organic matter, interim seeding, or leaving slopes in a roughened condition would reduce losses.

Redistributed soil would have a lower organic matter content as a result of salvage and stockpiling. Soil biological activity would be reduced or eliminated during stockpiling as a result of anaerobic conditions created in deeper portions of stockpiles. After soil redistribution, biological activity would slowly increase and eventually reach pre-salvage levels.

Redistribution of soil during reclamation would result in soil loss and compaction from loading, hauling, and placement. Soil loss would continue until vegetation is established.

Newmont's Reclamation Plan (1997a) describes best management practices (BMPs) that would be used to reduce sediment loss from disturbed areas (e.g., silt fences, straw bales, water diversion, and settling basins) throughout the life of the Project and during post-reclamation activities. Mitigation measures that would be implemented by Newmont include salvaging suitable soil for reclamation and seeding soil stockpiles to establish vegetative cover. This would reduce potential soil loss from wind and water in the soil stockpiles. Reclamation activities designed to reestablish premining topographic contours would use topsoil and grass species that enhance the percentage of ground covered with vegetation (Lewicki 1997). Newmont would perform interim and, when possible, final reclamation concurrently with mining activities (Newmont 1997a). Such measures would reduce the duration of time that soil is exposed to erosional elements.

Soil loss from erosion from the Leeville Project site was predicted using the Revised Universal Soil Loss Equation (RUSLE) for both pre-mine and post-mine conditions (Newmont 1997a). The erosion analysis was conducted for seven cross-sections through the proposed mine area. Pre-mine site conditions include sparse upland vegetation dominated by sagebrush and rabbitbrush on slopes ranging from 15 to 40 percent north of Rodeo Creek and up to 50 percent south of the creek. Elevations range from 6,100 to 6,600 feet AMSL. For post-mining site conditions, a minimum of 12 inches of soil would be replaced during reclamation. Final revegetation cover after reclamation would be similar to the pre-mine site, but with a higher percentage of grass cover and a lower percentage of shrub cover.

With the exception of the waste rock disposal facility, the results of the RUSLE analysis show that soil erosion rates for the pre-mine conditions are higher than predicted erosion rates for the respective post-mine cross-sections. The erosion rates are up to 6.08 tons/acre/year for pre-mine conditions, and up to 2.53 tons/acre/year for post-mine conditions. According to the analysis (Newmont 1997a), the post-mine erosion is lower than pre-mine erosion due to two primary reasons: (1) the post-mine landscape would have a higher percentage of grass cover; and (2) post-mine topography would consist of short, steep slopes and long, mild slopes, while the pre-mine condition generally consists of long, steady slopes. The proposed waste rock disposal facility site is a special case since the original terrain has mild slopes of about 5 to 10 percent, while the post-mine condition would include steeper grades of about 35 percent.

Transportation and use of Hazardous Materials in the Project area could potentially impact soil resources. Impacts to soil resources would vary depending on location and substance(s) released/spilled. Newmont has implemented an Emergency Response Plan (Newmont 1995b) and Spill Prevention, Control, and Countermeasure (SPCC) plan (Newmont 1995c) to address accidental spills or releases of

Hazardous Materials. Accidental spills or releases due to malfunctioning components would be contained and remediated in accordance with these plans and applicable state and federal regulations.

Indirect impacts on other resources caused by soil disturbance from the Proposed Action include:

- Changes in water quality due to sedimentation from erosion of exposed slopes;
- Decreased vegetative productivity due to soil loss or inadequate cover soil depth;
- Impacts on hydric soil supporting wetland and riparian vegetation; and
- Decreased land utility.

Alternatives A and B

Impacts to the soil resource resulting from implementation of Alternative A and/or B would be similar to those described for the Proposed Action.

Alternative C

Impacts to the soil resource resulting from implementation of Alternative C would be reduced commensurate with 118 acres less new surface disturbance.

Cumulative Impacts

Because mining is expected to continue as a major activity in the Carlin Trend, impacts to the soil resource from mining, in addition to grazing, mine exploration, and other construction and restoration activities in the area, would continue to occur at various levels. Associated impacts from these activities would include loss of soil productivity due to changes in soil structure from mixing and handling, water and wind driven soil losses, water quality impacts due to sedimentation, and compaction from roads, construction, and livestock grazing. See **Table 4-1** for a list of existing and reasonably foreseeable mining disturbance and associated acres disturbed in the Carlin Trend.

Reclamation associated with past mining disturbance and future restoration activities would ameliorate soil loss and productivity loss. Soil salvaged and used in reclamation would become viable once vegetation is established.

Potential Mitigation and Monitoring Measures

Implementation of reclamation activities and BMPs outlined in Newmont's Plan of Operations would reduce potential soil loss associated with the Leeville Project. Newmont would recalculate potential soil loss using the RUSLE model and would input information from the Order II Soil Survey.

Irreversible and Irretrievable Commitment of Resources

Soil loss as a result of erosional or anthro-pogenic-caused forces is irreversible and irretrievable.

Residual Adverse Effects and Impacts of Mitigation

Loss of soil and interruption of natural soil processes and functions (e.g., soil development, infiltration, percolation, water holding capacity, structure, biological activity, and organic matter) can be reversed by natural soil development over an unknown period. Reclamation efforts would expedite those processes. Loss of vegetation productivity as a result of soil impacts and land uses could be reversed within 5 to 10 years after successful reclamation.

VEGETATION

Summary

Implementing the Proposed Action would result in disturbance of rangeland vegetation communities, consisting primarily of 10 vegetation types. Reclamation would occur on disturbed sites after mining activities cease, though some areas (e.g., rock faces) would not be reclaimed with soil and vegetation. Impacts resulting from implementation of Alternative A and/or B would be the same as those described for the Proposed Action. Impacts on vegetation resulting from implementation of Alternative C would be reduced commensurate with 118 acres less new surface disturbance.

Direct and Indirect Impacts

Proposed Action

The Proposed Action would directly impact native vegetation at the mine site, along the discharge pipeline/canal route, and at ancillary facilities such as haul roads. Direct impacts include vegetation removal, soil compaction, and disturbance. Vegetation would be removed from approximately 486 acres. Proposed reclamation would reestablish vegetation on these sites.

Springs and seeps in the vicinity are shown in **Figure 3-10**. Four springs and seeps have been identified and mapped in the Project area as well as numerous springs and seeps to the north and east. **Figure 3-10** also illustrates perennial stream segments. There are no perennial stream segments in the Project area. The nearest perennial stream segments are in a portion of Sheep Creek and upper reaches of Simon and Lynn creeks; all approximately 1 mile from the Project area. Rodeo Creek drains the majority of the Project area. This stream is intermittent, flowing primarily during spring months (March–June). Nevada Division of Wildlife personnel report that Rodeo Creek is essentially 'a ditch' with no riparian vegetation or vegetated streambanks in the Project area (Lamp 2001).

Transportation and use of hazardous materials in the Project area could potentially impact vegetation resources. Direct impacts to vegetation resources and indirect impacts to livestock and wildlife would vary depending on location and substance(s) released/spilled. Newmont has implemented an Emergency Response Plan (Newmont 1995b) and Spill Prevention, Control, and Countermeasure (SPCC) plan (Newmont 1995c) to address accidental spills or releases of hazardous materials. Accidental spills or releases due to malfunctioning components would be contained and remediated in accordance with these plans and applicable state and federal regulations.

There would be a potential for noxious weed invasion or spread to disturbed sites (see following section: *Invasive, Nonnative Species*).

Alternatives A and B

Impacts associated with Alternatives A and/or B would be similar to those described for the Proposed Action.

Alternative C

Impacts on vegetation resulting from implementation of Alternative C would be reduced commensurate with 118 acres less surface disturbance.

No Action Alternative

Vegetation resources in the area would not be impacted by implementing the No Action Alternative since no ground disturbance associated with mining activities would occur. Impacts to vegetation associated with other ground disturbing activities in the area, including livestock grazing, would continue.

Cumulative Impacts

The cumulative impact area for vegetation resources encompasses areas disturbed by mining in the Carlin Trend. Cumulative impacts to the area's vegetation are directly related to those discussed in the *Soils* section above. Mine development, road construction, facility construction, and livestock grazing would impact vegetation on those sites.

Cumulative impacts to vegetation associated with wetlands/riparian zones would be expected as a result of dewatering activities associated with mining activity.

Past, present and reasonably foreseeable mining activity would result in disturbance of 32,962 acres, of which 6,412 acres are open pits. Under BLM and NDEP permit requirements approximately 26,550 acres would be revegetated.

Potential Mitigation and Monitoring Measures

Potential mitigation measures include using locally adapted native seed for reclamation efforts accompanied by soil augmentation, if necessary, to improve chances of reclamation success. Shrub planting could be considered where appropriate and livestock exclusion on reclaimed areas would occur until vegetation has become established. A weed monitoring and control plan would be developed to ensure that reclaimed areas would be protected from noxious weed invasion. See *Grazing Management* section in this chapter for additional potential mitigation and monitoring measures.

Irreversible and Irretrievable Commitment of Resources

Vegetation productivity would be lost from disturbed sites until successful reclamation and revegetation efforts are completed.

Residual Adverse Effects and Impacts of Mitigation

As disclosed in the *Water Quality and Quantity* section, dewatering at the Leeville Mine is not expected to impact springs and seeps beyond what has or will occur from regional dewatering at the Goldstrike Property and Gold Quarry mines, however, recovery time for the water table would increase. This could increase recovery time for vegetation affected by drawdown. Residual impacts may remain in areas where reclamation would not occur, such as rock faces. No residual adverse impacts are foreseen from implementation of mitigation measures.

INVASIVE, NONNATIVE SPECIES

Summary

Implementing the Proposed Action would result in disturbance of 486 acres of rangeland vegetation. Construction activities such as roads, ancillary facilities, pipelines, production and ventilation shafts, exploration pits, and rock stockpiles would remove native sagebrush/bunchgrass communities and expose the areas to colonization by invasive, nonnative species. Establishment of noxious weeds can lead to ecological degradation. Impacts resulting from implementation of Alternative A and/or B would be the same as described for the Proposed Action. Implementation of Alternative C would result in 118 fewer acres of disturbance and less opportunity for establishment of invasive, nonnative species.

Direct and Indirect Impacts

Proposed Action

Soil disturbance provides an opportunity for noxious weed establishment. The Proposed Action would create approximately 486 acres of new disturbance resulting from mine development, exploration activities, construction of waste rock disposal facilities, refractory ore stockpile areas, discharge pipeline and canal system, and ancillary facilities.

Increased human activity could increase potential for wildfire, with subsequent spread of invasive annuals such as cheatgrass, and loss of native shrubs. Increased human presence would also increase likelihood that wildfires would be quickly controlled. Increased vehicle activity could increase potential for entry and spread of noxious weed species because weed seeds are often lodged in vehicle under carriages and tires.

Changes in grazing management practices associated with the Proposed Action could affect spread of noxious weeds. Elimination of grazing from mine properties through the life-of-mine would increase vigor of native shrubs and grasses, decreasing potential for weed infestations on undisturbed land.

Alternatives A and B

Impacts resulting from implementation of Alternative A and/or B would be similar to those described for the Proposed Action.

Alternative C

Impacts of invasive, nonnative species resulting from implementation of Alternative C would be reduced commensurate with 118 acres less new surface disturbance.

No Action Alternative

If the No Action Alternative were implemented, there would be no new impacts beyond those already present. Noxious weed populations could increase because of other non-mining related disturbance, such as grazing, road maintenance, recreation, and vehicle activity.

Cumulative Impacts

Impacts from an increase in invasive, nonnative species on the Project area would add to noxious weeds established throughout the Carlin Trend. Any additional increase incrementally decreases economic productivity and ecological integrity of the land.

Potential Mitigation and Monitoring Measures

Newmont would conduct annual weed surveys to direct weed control efforts. Monitoring infestations and weed control would continue until reclamation is complete and potential for weed invasion is minimized. Newmont's weed control efforts would be continued for the life-of-mine and reclamation period to reduce potential impacts of new infestations. Where straw bales are used for sediment control, certified weed free straw bales would be used.

Irreversible and Irretrievable Commitment of Resources

Where weed infestations are significant, they represent an irretrievable commitment of range productivity. During mining operations, infestations are not preventing use of the range because livestock would not be allowed to graze in the area. If noxious weeds are not controlled during reclamation, loss of range productivity would occur after mining and reclamation are complete.

Residual Adverse Effect and Impacts of Mitigation

Potential adverse impacts on some native plant communities could result from use of herbicides in a weed control program. Proper application of herbicides would reduce potential impacts to water and wildlife resources.

WETLANDS/RIPARIAN ZONES

Summary

Potential impacts to wetlands and riparian zones resulting from the Proposed Action would include an extension of the duration of water table drawdown (by about 20 years) created by existing dewatering operations in the Carlin Trend. This would delay restoration of up to 70 acres of wetlands and riparian zones located in the area of potential effect associated with Leeville dewatering.

Discharge of excess water from the Leeville dewatering system would infiltrate into the TS Ranch Reservoir, other infiltration basins, or would be used for irrigation in the Boulder Valley. This discharge would continue to support flow in three major springs located in the Boulder Valley (Sand Dune, Green, and Knob springs).

Direct and Indirect Impacts

Proposed Action

Dewatering activities at the proposed Leeville Project would remove additional groundwater from the cone of depression created by existing dewatering in the Carlin Trend and prolong water table recovery within the area directly affected by the Leeville dewatering system by approximately 20 years. This would result in a longer period of recovery for up to 70 acres of riparian vegetation potentially affected by Leeville dewatering. These 70 acres of riparian vegetation lie within the predicted area of direct effect of Leeville dewatering (see **Figure 4-2**) below 6,000 feet elevation and include 40 acres of herbaceous streambar, 29 acres of wet meadow, and 1 acre of salexi-wet meadow. Information regarding the location of springs, seeps, and streams potentially affected by the Leeville dewatering system are described in the *Water Quality and Quantity* in this chapter.

Drying or reduced flow for springs, seeps, and streams, if any, would result in loss of riparian and wetland vegetation associated with these features. The type of impact and/or severity of the effect on springs, seeps, and stream reaches as a result of dewatering activities depends on the source of groundwater sustaining the feature and the degree of connectedness between surface water and deeper groundwater sources.

Restoration of flow to these sites would result in recolonization by wetland and riparian species.

Alternative A, B, and/or C

Impacts to wetlands and riparian zones associated with implementation of Alternatives A, B, and/or C would be similar to those described for the Proposed Action.

No Action Alternative

Implementation of the No Action Alternative would not impact wetlands/riparian zones in the Project area beyond those impacts that have or will occur as a result of other dewatering operations.

Cumulative Impacts

Cumulative impacts associated with dewatering and water management activities at the Goldstrike Property, Gold Quarry, and Leeville mines are included in the Cumulative Impacts Analysis report prepared by BLM (2000a). The hydrologic study area for cumulative impacts encompasses approximately 2,060 square miles (1.3 million acres) and includes six designated groundwater basins. Riparian habitat inventories within this area have identified and classified approximately 4,337 acres of riparian/wetland habitat (BLM 2000a).

Approximately 600 acres (14 percent) of the 4,337 acres of riparian vegetation occur within the area where perennial water could be impacted by cumulative groundwater drawdown. The remaining 3,737 acres of riparian vegetation within the cumulative effects area are considered less likely to be affected by groundwater drawdown (BLM 2000a).

Cumulative impacts to wetlands and riparian zones, including loss of wetland species would be expected as a result of dewatering activities associated with mining operations. Potential changes in structure and composition of riparian vegetation may occur as a result of long-term, cumulative groundwater drawdown within Carlin Trend watersheds.

Potential Mitigation and Monitoring Measures

No mitigation or monitoring measures are proposed beyond those presently being conducted by Newmont and those described in Potential Mitigation and Monitoring Measures in *Water Quantity and Quality* section of this chapter.

Irreversible and Irretrievable Commitment of Resources

No irreversible and irretrievable commitment of wetlands and riparian zone resources would occur as a result of the Proposed Action.

Residual Adverse Effects and Impacts of Mitigation

Dewatering associated with the Leeville Project is not expected to impact wetlands and riparian zones beyond what has or would occur from regional dewatering at the Goldstrike Property and Gold Quarry Mine, except to extend the period of recovery by about 20 years. There would be no residual adverse effects to wetlands and riparian zones associated with the Leeville Project from implementation of mitigation measures.

FISHERIES AND AQUATIC RESOURCES

Summary

No fisheries or aquatic resources have been identified in the Leeville Project area where land disturbance is proposed; therefore, implementation of the Proposed Action or Alternatives would have no direct impact on these resources in the proposed mine area. Dewatering activities at Leeville would prolong water table recovery within the area affected by Leeville's dewatering by approximately 20 years. This would result in a longer period for recovery of stream flow potentially reduced by current dewatering operations in the Carlin Trend; thus lengthening the recovery period of any impacted aquatic habitat in these streams.

Direct and Indirect Impacts

Proposed Action

No direct impacts to aquatic habitat or fisheries are expected within the project boundary as a result of the Proposed Action or any of the Alternatives. Construction activities for the Leeville Mine would be in the headwaters of Rodeo Creek where flow is intermittent or ephemeral and no aquatic habitat or fisheries have been documented.

Dewatering activities at the proposed Leeville Project would prolong water table recovery to within 90 percent of the premining water table elevation within the area affected by Leeville's dewatering by approximately 20 years. This would result in a longer time period for recovery of stream flow potentially reduced by current dewatering operations in the Carlin Trend; thus lengthening the time for recovery of any impacted aquatic habitat in these streams. Streams included in the direct impact area associated with the Leeville Project dewatering system include upper Simon Creek, upper Lynn Creek, and middle Maggie Creek (the Narrows), Rodeo, Sheep, Soap, Welches, Marys, James, and Cottonwood creeks (see **Figure 4-2**).

The additional 20-year recovery period to establish 90 percent of the premining water table condition represents a 4 to 6 percent increase in the predicted recovery period associated with cessation of pumping for current dewatering systems in the Carlin Trend. The extension of the recovery period would not result in any new or different impacts than those that could potentially result from existing dewatering activities.

Alternatives A, B, and C

Impacts resulting from implementation of Alternatives A, B, and/or C would be similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, Newmont would not be authorized to develop the defined ore reserves or undertake any of the previously described associated activities. Potential impacts to fisheries and aquatic resources projected to result from development of the Leeville project would not be realized. Impacts from ongoing mine dewatering in the Carlin Trend would continue.

Cumulative Impacts

The cumulative impacts area for fisheries and aquatic resources includes the Maggie Creek drainage; portions of the Susie Creek drainage; Boulder, Antelope, Rodeo, Brush, and Bell creeks in the Boulder Valley and the Little Boulder Basin; and the Humboldt River from Carlin to Palisade. The cumulative impacts area evaluated for the threatened Lahontan cutthroat trout includes the Maggie Creek drainage, portions of the Susie Creek drainage, and the Humboldt River from Carlin to Palisade (see *Threatened, Endangered, Candidate and Sensitive Species* section in this chapter).

Potential cumulative impacts to these resources would include degradation of aquatic habitat from livestock grazing, mining (dewatering activity), roads, wildfire, and in some cases agricultural diversions. With the exception of the Maggie and Marys creek subbasins, most Lahontan cutthroat trout streams in the Humboldt River basin are generally declining in habitat quality due to the aforementioned reasons (A. A. Rich and Associates 1999; BLM 2000a). However, no impacts caused by mine dewatering have been documented to date.

The magnitude of base flow reduction to area streams (e.g., Marys, Maggie, Beaver, and Boulder creeks and the Humboldt River) resulting from the addition of Leeville dewatering to existing dewatering in the Carlin Trend is predicted to be 0.1 cfs or less for each stream or river segment identified above. A reduction of 0.1 cfs or less for flow in Maggie Creek is 2.7 percent of the mean October baseflow of 3.7 cfs in the creek as measured Maggie Creek Canyon (USGS 2000). For combined mine dewatering in the Carlin Trend, predicted maximum reductions in flow for streams potentially affected by Leeville dewatering on a cumulative basis would be: Humboldt River = 8 cfs; Boulder Creek – 0.1 cfs; upper Maggie Creek = 0.8 cfs; and Marys Creek = 1.9 cfs (BLM 2000a) (see *Water Quantity and Quality* section of this chapter).

Maggie Creek Watershed Restoration Project has improved riparian and stream habitat since 1993. The program was designed to enhance 1,982 acres of riparian habitat, 40,000 acres of upland watershed, and 82 miles of stream channel in Maggie Creek Basin (BLM 2000c).

In November 1993, BLM adopted the South Operations Area Project (SOAP) Mitigation Plan in conjunction with the Final EIS, Newmont Gold Company's South Operations Area Project (BLM 1993b). The cumulative impacts area for SOAP coincides with the Leeville Project. Measures included in the SOAP mitigation plan address potential adverse impacts, including dewatering impacts, without regard to whether they occur on public or private land. These measures are designed to provide not only protection of natural resources but also improvement of most resources in the area, including aquatic habitat. Measures in the plan that deal directly with dewatering include extensive groundwater monitoring and reporting protocols. Monitoring data are used to trigger implementation of mitigation measures, including streamflow augmentation, for individual springs, seeps, and streams if and when the cone of depression impacts groundwater recharge to those water resources (see Maggie Creek Streamflow Augmentation Plan (BLM 1993b)). Full implementation of the SOAP mitigation plan would have a beneficial impact to fisheries and aquatic resources, including Lahontan cutthroat trout, in the cumulative impact area.

Dewatering at the Leeville Mine would extend the recovery period of regional groundwater levels. Impacts to groundwater and surface flow attributable to the Leeville Project would be offset by these mitigation activities.

Potential Mitigation and Monitoring Measures

Newmont's ongoing mitigation activities in upper Maggie Creek drainage as described above (BLM 1993b) are designed to reduce potential impacts of Newmont's South Operations Area Project on fisheries and aquatic resources. Newmont and BLM continue to monitor performance of this restoration project including riparian areas, aquatic habitat, and streamflow. Newmont in conjunction with BLM, is currently revising the SOAP Mitigation Plan to address potential impacts associated with the proposed amendment to the SOAP Plan of Operations.

Water monitoring activities by Newmont and Barrick would continue in the Project area. The Leeville Project would require extending the duration of monitoring programs commensurate with the predicted delay (approximately 20 years) in recovery of the water table. Additional monitoring wells and springs would be added to the monitoring network as described in the *Water Quantity and Quality* section in this chapter.

Irreversible and Irretrievable Commitment of Resources

No irreversible or irretrievable commitment of fisheries and aquatic resources are predicted to result from implementation of the Proposed Action and Alternatives.

Residual Adverse Effects and Impacts of Mitigation

As discussed previously, mine dewatering has the potential to reduce surface water flow in some area streams where there is connection between groundwater and the stream. Residual impacts that could be associated with the Leeville Project include potential increase in the recovery period for groundwater levels. These residual impacts would exist under any of the action alternatives. Successful implementation of mitigation described above would offset residual impacts.

TERRESTRIAL WILDLIFE

Summary

Direct impacts to terrestrial wildlife resulting from the Proposed Action at the Leeville Mine site would be loss of habitat and the subsequent displacement or loss of wildlife. Direct loss of wildlife habitat would eliminate cover (nesting, hiding, and thermal), breeding sites, and forage. Most of the affected habitat within the Project area consists of sagebrush/bunchgrass communities. Construction of new haul roads, ancillary facilities, and mine development would result in 486 acres of habitat loss.

Loss of 486 acres of primarily sagebrush habitat would directly impact wildlife using that habitat, including pronghorn antelope, mule deer, small mammals, reptiles, and birds. Other direct impacts include potential vehicle collisions (birds, mammals, reptiles), powerline collisions (birds), and drowning in the proposed canal (small mammals, reptiles). Indirect impacts to wildlife include potential alteration and loss of riparian habitat, primarily off site. Although most of the Project area is marginal habitat for many species, and has already been affected by other mining related activities in the Carlin Trend, impacts to wildlife are expected.

Implementation of Alternative A would eliminate the potential physical hazard posed to wildlife along 5,700 feet of open canal between the mine and the existing water treatment plant near the TS Ranch Reservoir. Implementation of Alternative B or C would result in impacts on terrestrial wildlife similar to those described for the Proposed Action.

Direct and Indirect Impacts

Proposed Action

The Proposed Action would result in incremental surface disturbance of approximately 486 acres, including 453 acres of public land and 33 acres of private land. Terrestrial wildlife currently inhabiting this area would likely be displaced during construction and mining activities.

Species with low mobility, such as some reptiles and small mammals, would most likely die during the initial disturbance activities. Wildlife with greater mobility, or that use the area as part of their home range, would be displaced to adjacent habitat. Animals also may be displaced from habitat adjacent to disturbed acreage by increased activity, noise, and dust. Eventually, some animals may adapt to and re-inhabit undisturbed areas. As reclamation occurs, wildlife populations would re-inhabit the area. As reclamation vegetation matures and begins to resemble the original vegetation in composition and density, wildlife use of the area may approach that of pre-disturbance .

Though all of the Project area lies within potential mule deer range, much of the area is sub-optimal, or has been impacted by other mining activities in the Carlin Trend, and therefore use is low throughout most of the year (Gray 2001). The eastern part of the Project area lies within mule deer transitional range. Most of the mule deer that migrate through the area, moving between summer ranges to the north and winter ranges to the south, now use the eastern flanks of the Tuscarora Range (BLM 1993a; Gray 2001). An unknown number of migrating deer (though a small percentage of the total migrating deer) do pass through the Rodeo Creek drainage and would be directly displaced by the Proposed Action (Gray 2001). Potentially greater levels of stress, increased competition with other mule deer, and potentially lower nutritional levels upon reaching winter range, may impact a small percentage of mule deer migrating through the area. A small but unquantifiable addition to mule deer mortality may occur because of these factors. An increase in mule deer mortality caused by collisions with vehicles would be expected as a direct result of higher volumes of traffic associated with mine development in the immediate mine area. Despite an increase in direct mortality, and a displacement of some mule deer from a part of their range, impact to the mule deer population attributable to activities associated with the Leeville Project is small.

The higher elevations of the Project area, including the area where mining and most ancillary facilities would occur, is relatively poor pronghorn antelope habitat and is not inhabited by pronghorn (Gray 2001).

A 42-inch diameter steel pipeline would be constructed for transporting water from the Project site to the existing Boulder Valley water management system. The pipeline would be buried except in rock areas, where trenching would be impractical. A buried pipeline would minimize interference with movements of terrestrial wildlife in the Project area.

The last segment of the pipeline and canal system would be comprised of a 5,700-foot long open canal terminating at the TS Ranch Reservoir. The canal would pass through flats in the Boulder Valley that are crucial summer range for pronghorn antelope (Gray 2001). Habitat loss from construction of the canal, and disturbance associated with monitoring and maintenance activities, would directly impact pronghorn using this area, and would increase cumulative impacts to this herd.

The proposed canal would be constructed to an average depth of 3.5 feet and lined with a geotextile liner. The canal would have a nominal bottom width of 15-feet with sloping sides of 3H:1V. No fencing is proposed to exclude wildlife or livestock from the canal. The open canal could cause disruption of pronghorn antelope movements and drowning of animals, including mammals, birds, and reptiles would occur.

A minor loss of upland habitat (steep, rocky slopes) suitable for chukar would occur as a result of the Proposed Action. The surrounding area provides habitat in ample abundance so that habitat losses caused by the Proposed Action would not likely disrupt chukar populations.

Low density populations of Hungarian partridge are widely distributed in the area. Loss of habitat as a result of the Proposed Action would be minor because adequate suitable habitat is available in the surrounding area. Prime habitat for mourning doves does not exist within the Project area and, therefore, would not be impacted by the Proposed Action.

Effects to migratory shorebirds and waterfowl would be minimal. The mine water sump would be approximately one acre of open water, when full, in an area of high disturbance, and would provide no food source. Thus, its value as a waterfowl and shorebird attractant would be minimal.

Impact to nongame birds and terrestrial reptiles would include direct loss of 486 acres of upland habitat, reducing forage and nesting habitat. As the amount of habitat lost compared to that available is minor, impacts are expected to be minor. No impact to amphibians is expected.

Raptors would be moderately affected by the Proposed Action due to a possible reduction in prey base caused by the loss of 486 acres of upland habitat. Because most raptors range over a large area, it is difficult to quantify how detrimental the loss of habitat would be. Due to the relatively small acreage affected, loss of prey base would probably be minor and raptor diversity in the area would likely remain unchanged.

Relocation of the existing powerline in the Leeville Project area would not result in measurable impacts to terrestrial wildlife. The configuration of the poles would remain the same as the current transmission line.

Effects of noise on wild animals can be classified as those affecting auditory physiology and sensory perception, those affecting behavior, and those affecting populations (Bowles 1995). Physiological and sensory perception in wildlife is not likely to be affected by noise generated by a mining operation. Wild animals can move away from a disturbance, and negative impacts to physiology or sensory perception are generally from chronic exposure. Many noises generated by mining operations are likely to be sporadic, impulsive, and fluctuating in intensity and duration. Potential impacts to wildlife include 'masking' of sounds made by predators, increasing the risk of predation, and 'masking' of social signals. Fluctuating noise levels may elevate heart rate, catecholamine levels, and corticosteroid levels in wild animals for short periods of time, but these elevated levels are generally of short duration, and animals often habituate to these disturbances over time. Short term increases of these measures do not correlate well with stress level experienced by the animal (Bowles 1995). Noise is an environmental stressor, and with repeated exposure all vertebrate animals habituate, or adapt behaviorally and physiologically (Bowles 1995).

Behaviors that may be impacted by noise include habitat use, courtship and mating, predator avoidance, and migration (Bowles 1995). Ungulates typically avoid areas where noise is present and return when it is not. A study conducted by the Idaho Game and Fish Department concluded that human harassment and simulated noise generated by mining activity caused elk to abandon traditional calving areas. Some cow/calf pairs moved several miles in response to disturbance, often into sub-optimal habitat (Kuck et al. 1985). If noises are of brief duration and the animal has good cover, change in home range size is not detectable. If mammals are repeatedly exposed to the same noise without harassment, responses to noise decline rapidly (Bowles 1995). Migration routes are not affected by noise, although short detours may increase energy expenditure (Bowles 1995).

No detectable changes in wildlife population size or growth rate have been documented due to noise. Most effects of noise disturbances are relatively mild (Bowles 1995).

Dust, heavy equipment exhaust fumes, and other air pollutants may render some vegetation unpalatable to some species, causing wildlife to be temporarily or permanently displaced. The extent to which wildlife would be impacted by these factors would be minor. No impacts to wildlife are expected from movement and storage of hazardous materials at the Leeville Project. Hazardous materials would be transported to the Leeville Project by United States Department of Transportation (USDOT) regulated transports and stored onsite in USDOT approved containers.

Alternative A

Implementation of Alternative A would eliminate exposure of wildlife to physical hazards associated with 5,700 feet of open canal. Water discharged from the mine into the pipeline and canal system would be treated to meet water quality standards (see *Water Treatment Facility* description section in Chapter 2).

Alternative B and/or C

Implementation of Alternative B and/or C would result in impacts to terrestrial wildlife similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative, Newmont would not be authorized to develop defined ore reserves or undertake any of the previously described associated activities. Potential impacts to terrestrial wildlife resources from development of the Project would not be realized. Impacts from ongoing mine activity in the Carlin Trend would continue under the No Action Alternative.

Cumulative Impacts

Cumulative impacts to terrestrial wildlife from activities in the area include those related to roads, haul truck traffic, habitat loss from mining, construction of ancillary facilities, dewatering activities, and water conveyance canals. The cumulative impact area extends from the Duck Valley Indian Reservation in the north to the Crescent Valley in the south.

The amount of reduced streamflow due to Leeville dewatering is predicted to be 0.1 cfs or less in each of Marys, Maggie, Beaver, and Boulder creeks and the Humboldt River. This reduction in baseflow would not adversely affect terrestrial wildlife.

Past, present, and future mine dewatering could reduce the amount and extent of available surface water and associated riparian habitats, including springs and seeps, in Maggie, Marys, and Boulder sub-basins, and along the Humboldt River. The magnitude of potential flow reduction is described in the *Water Quantity and Quality* section in this chapter.

Potential reduction or loss of available water, and the associated long-term changes in riparian vegetation, would result in a reduction of breeding, foraging, and cover habitats; increased animal displacement; reduction in overall plant and animal diversity; and possible long-term reduction in population numbers of some species (BLM 2000a). As vegetation changes occur, the incremental habitat loss would affect big game, upland game birds, waterfowl, shorebirds, raptors, songbirds, bats, and area reptiles and amphibians.

Cumulative impacts from habitat loss associated with open pits in the Carlin Trend can be attributed to the loss of approximately 4,800 acres of native rangeland due to existing and foreseeable mine disturbance (**Table 4-2)**.

Additional habitat loss (approximately 486 acres) due to road and facility construction would occur. While it is acknowledged habitat reduction has and would continue to occur in the Carlin Trend area, overall impact to the majority of native terrestrial species populations throughout north central Nevada would not likely be significantly adverse. However, development of the Project, in conjunction with all other mining activity, may further alter timing and location of traditional mule deer migration routes and may contribute to shifts in winter range use from the Dunphy Hills and the southern portion of the Tuscarora Range to the Izenhood and Sheep Creek ranges. The long-term significance of these potential shifts in winter range is not known.

Pronghorn antelope using the Boulder Valley would be subjected to additional stress from increased activity in the area, and from the necessity to avoid the proposed water conveyance canal. Some habitat would be lost due to construction of the canal. Loss of some pronghorn to drowning may occur. Though difficult to assess quantitatively, these impacts would contribute to a cumulative long-term loss in pronghorn numbers in the area.

Potential Mitigation and Monitoring Measures

Mitigation measures to offset predicted impacts to wildlife may include enhancement of offsite habitat as compensation for habitat loss due to unreclaimed areas associated with the Leeville Mine project. Direct impacts to mule deer through vehicle collisions could be reduced by implementing travel restrictions and reduced speed limits during peak migration times, in corridors where mule deer cross access roads.

The open canal segment of the groundwater conveyance system may cause disruption of pronghorn antelope movements and drowning of small mammals and reptiles. If the canal is fenced to keep livestock out of the canal, the fence should be designed to prevent wildlife from accessing the canal. Consideration should be given to providing one or two crossings (bridges) wide enough, and covered with soil and vegetation such that pronghorn antelope would use them. At a minimum, the canal liner should not be smooth plastic, but a fabric or substance that provides traction to animals falling into the canal. NDOW wildlife personnel have suggested a rock liner and slope of 5:1, rather than the proposed 3:1 smooth liner (Gray 2001; Lamp 2001).

Newmont would comply with the Migratory Bird Treaty Act by not conducting stripping operations during the breeding season (3/15-7/16) of ground nesting migratory birds using the area. If stripping is proposed during the breeding season, nest surveys would be conducted prior to disturbance and buffer zones would be used to protect identified nests.

The Sierra Pacific Power Company power line relocation should be constructed with predatory bird anti-perching devices on crossarms, tops of structures, above the crossing point of cross-braces, and either side of static wires, as needed.

Irreversible and Irretrievable Commitment of Resources

The Proposed Action describes reclamation of all disturbed areas to the extent that they would support wildlife habitat, domestic grazing, dispersed recreation, and mineral exploration and development. Reclamation methods would be employed that are technically effective, cost efficient, and require no post-reclamation maintenance to ensure continued performance. Disturbed surfaces would be re-established to support self-sustaining vegetation communities, control precipitation infiltration, and minimize erosion and sedimentation. A portion of rock faces associated with surface support facilities would not be reclaimed following cessation of mining. No wildlife resources would be irreversibly or irretrievably lost once reclamation has been completed. Wildlife diversity and population densities can be expected to recover to pre-disturbance levels over time.

Residual Adverse Impacts and Impacts of Mitigation

No residual adverse impacts to terrestrial wildlife are expected from the proposed Leeville Project. Impacts of mitigation measures described above would be positive.

THREATENED, ENDANGERED, CANDIDATE, AND SENSITIVE SPECIES

Summary

Direct impacts to threatened, endangered, candidate, and sensitive species or their habitat include incremental loss of habitat (including prey base) due to mine disturbance. Species with habitat potentially affected by the Project include goshawk, burrowing owl, sage grouse, Swainson's hawk, Preble's shrew, golden eagle, ferruginous hawk, and several species of bat (foraging and roosting habitat).

The magnitude of base flow reductions in area streams (e.g., Maggie, Marys, Beaver, and Boulder creeks and the Humboldt River) caused by adding Leeville dewatering to other dewatering operations in the Carlin Trend at any given time would be 0.1 cfs or less. Portions of three streams that support Lahontan cutthroat trout (LCT) (e.g., upper Coyote Creek, upper Little Jack Creek, and a mid-section of Beaver Creek) are within the predicted cumulative cone of depression in the Carlin Trend. Other stream segments and springs within the cumulative effects drawdown area support springsnails.

Impacts to threatened, endangered, candidate, and sensitive species from implementation of Alternatives, A, B, or C, would be similar to those described for the Proposed Action.

Direct and Indirect Impacts

The following subsections summarize potential direct and indirect impacts that would result from the proposed Leeville Project and alternatives.

Proposed Action

Some animals could be caught in the open canal portion of the water discharge system between the proposed water treatment plant and the TS Ranch Reservoir. The synthetic liner in the canal and velocity of the water could result in animals drowning.

Incremental loss of prey base would result from direct land disturbance totaling 486 acres for the Leeville Project. The Leeville Project is located adjacent to mine disturbance associated with Newmont's North Operations Area, the Lantern Mine, Section 36 Project, and Carlin Mine. These mine activities have resulted in displacing some animals and changing the characteristics of the prey base for other animals. The loss of 486 acres at the Leeville Project is not expected to further impact species that rely on the prey base in the Leeville Project Area.

Proposed dewatering activities at the Leeville Project would add approximately 20 years to the recovery period of the water table potentially being impacted by dewatering systems in the Carlin Trend. The extension to the recovery period would not result in new or different impacts to threatened, endangered, candidate and sensitive species beyond those predicted to occur as a result of current dewatering or recovery period.

Bald Eagle

Bald eagles are present in the vicinity of the Project as winter residents and seasonal migrants, usually associated with ice-free bodies of water. A few wintering bald eagles are present along the Humboldt River, attracted to open water and availability of prey (waterfowl and fish). Wintering bald eagles are mobile and readily move to new areas if prey becomes available. Bald eagles could be attracted to road kills (deer, rabbits) on haul roads.

Bald eagles are frequently killed while feeding on mule deer and rabbit carcasses on highways. This may account for up to 25 percent of the annual bald eagle mortality (Hazelwood 2000). To determine the potential impact, it is necessary to assess how many mule deer are killed on haul roads, and when. If mule deer are being killed while bald eagles are in the area, then there is a potential, though non-quantifiable problem. During winter months, when bald eagle numbers reach their peak, mule deer have migrated south to their winter range, and would likely not pose a problem on area mine roads. Road-killed rabbits occur on a year-round basis on highways or roads that are used by highway traffic.

Lahontan Cutthroat Trout

Because impacts to surface water currently occupied by LCT would not occur as a direct result of the Leeville Project, no measurable direct or indirect impacts to LCT are expected to occur. **Figure 4-2** depicts groundwater drawdown associated with the Leeville Project and the location of LCT habitat in the vicinity of the Leeville Project.

Preble's Shrew

Extension of the duration of dewatering impacts associated with the Leeville Project would extend the time period for potential loss of flow in some springs, seeps, and stream reaches within the areas of potential impact. This extension of impact could reduce the amount of suitable habitat for this shrew species (BLM 2000a). The direct loss of 486 acres of upland habitat due to mine disturbance may also reduce habitat for this species.

Sensitive Bat Species

Five sensitive species of bats have been identified as potentially occurring in the vicinity of the Leeville Project. Day and night roosts, hibernacula, and maternity roosts for these species would not likely be directly impacted by the Project. Potential impacts include loss of upland foraging habitat. Compared to the total amount of upland habitat available and the relatively poor foraging habitat it represents for bats, the impact to bats due to loss of upland habitat would be minimal.

Golden Eagle

Potential impacts to golden eagles are primarily associated with the direct loss of upland habitat for potential prey species. Because the amount of upland habitat lost during the life-of-mine is small compared to the amount of upland habitat available, and habitat would be reclaimed after mine operations cease, impacts to golden eagles would be minimal.

Direct loss of golden eagles may occur from collisions with vehicle on haul roads and other mine-related traffic. Losses may also occur from electrocution or collision with powerlines associated with mine facilities.

Osprey

No impacts to osprey are anticipated as a direct or indirect impact of the proposed Project as this species is rare in this area. Osprey would not be expected to roost or forage along smaller streams, springs, or seeps, in the area that might be impacted by the Project. No effects are expected to occur to Willow Creek Reservoir, where osprey habitat exists.

Northern Goshawk

Northern goshawks are not expected to be impacted by the Project directly. Indirect impacts to this species would correspond to any incremental loss of habitat for goshawk prey due to proposed mine disturbance, though these potential impacts are not likely to affect distribution and/or abundance of goshawks in northern Nevada.

Swainson's Hawk

The likelihood of Swainson's hawks nesting and foraging within the area impacted by the Leeville Project is low, based upon the species' current distribution in northern Nevada (BLM 2000a). A reduction in prey abundance and a loss of potential roosting habitat due to the direct loss of upland habitat would not likely impact the distribution and/or abundance of this raptor species in northern Nevada.

Ferruginous Hawk

The success of nesting raptors is often closely associated with the available prey base, and prey availability is particularly important to nesting ferruginous hawks (BLM 2000a). Reduction in upland habitat from direct mine disturbance could reduce potential prey base for ferruginous hawks, although mining activity bordering the proposed Leeville Project has already affected ferruginous hawk habitat in the area (BLM 2000a).

Burrowing Owl

Upland nesting, roosting, or foraging habitat of this species could be affected by the proposed Project. Construction and land disturbance activities would destroy any existing habitat inside the footprint of mine disturbance. The nearest known burrowing owl population is in the lower Boulder Valley (BLM 2000a).

Sage Grouse

Sage grouse may nest and forage in sagebrush/ grassland habitat affected by the Proposed Action. Incremental loss of this habitat may contribute to local declines in sage grouse populations. Some individuals could be lost from the population, but losses attributable to the Project would not likely affect viability of local populations. No known leks (courtship areas) or wintering areas would be affected by development of the proposed Project or alternatives.

Lewis Buckwheat

Lewis buckwheat is a small plant that is restricted to dry, open, relatively barren and undisturbed convex ridges and crests underlain by silicaceous carbonate and limestone rock types on all aspects (BLM 2000a). Typical habitat is characterized by sparse to moderately dense vegetation, including low sagebrush, rubber rabbitbrush, Indian ricegrass, and squirrel tail bottlebrush. A total of 33 populations are known to occur in an area north of Emigrant Pass and adjacent Marys Mountain. No known populations would be affected by the Proposed Action.

Columbia Spotted Frog

No direct or indirect impacts to Columbia spotted frog or its habitat are anticipated due to the Project.

Nevada Viceroy

Nevada Viceroy is associated with willows below 6,000 feet elevation. Predicted impacts to surface water flow that would affect maintenance of willow communities are not expected to reduce the amount and quality of habitat for this species. However, the delay in recovery of the water table as a result of the Leeville dewatering system would also delay recovery of willows in areas affected by existing dewatering.

California Floater

The Proposed Action is not predicted to cause any reduction in stream flow in stream reaches where the species has been documented, therefore, no direct or indirect impacts to California floaters are expected.

Springsnail

Springsnail populations are known to occur at six springs in upper Antelope Creek, one spring in upper Willow Creek, Warm Spring in Marys Creek basin, and Warm Billy Spring and Rattlesnake Spring in the Boulder Creek subbasin. No populations have been found in the Maggie Creek basin or the remainder of the area potentially affected by dewatering systems proposed for the Leeville Project.

Alternative A

Implementation of Alternative A would eliminate the potential for animals to be caught in an open canal and drown.

Alternative B and/or C

Implementation of Alternative B and/or C would have no measurable change on impacts to threatened, endangered, candidate, or sensitive species.

No Action Alternative

The No Action Alternative would not affect threatened, endangered, candidate or sensitive species from Leeville Mine activities. Impacts resulting from other mines and dewatering in the Carlin Trend would continue.

Cumulative Impacts

Potential cumulative impacts on threatened, endangered, candidate, and sensitive species as a result of dewatering activities at Leeville, South Operations Area, and the Goldstrike Property are addressed in the Cumulative Impact Analysis report prepared by BLM (2000a). This report indicates cumulative impacts could occur in Maggie, Susie, and Boulder creeks drainages and the Humboldt River due to dewatering activities of mines in the Carlin Trend. Habitat for California floaters, Columbia spotted frog, LCT and springsnails may be affected by addition of Leeville dewatering to existing dewatering operations in the Carlin Trend.

The magnitude of base flow reduction to area streams (e.g., Marys, Maggie, Beaver, and Boulder creeks and the Humboldt River) resulting from the addition of Leeville dewatering to existing dewatering in the Carlin Trend is predicted to be 0.1 cfs or less for each stream or river segment identified above. A reduction of 0.1 cfs or less for flow in Maggie Creek is 2.7 percent of the mean October baseflow of 3.7 cfs in the creek as measured in Maggie Creek Canyon (USGS 2000). For combined mine dewatering in the Carlin Trend, predicted maximum reductions in flow for streams potentially affected by Leeville dewatering on a cumulative basis would be: Humboldt River = 8 cfs; Boulder Creek = 0.1 cfs; upper Maggie Creek = 0.8 cfs; and Marys Creek = 1.9 cfs (BLM 2000a) (see *Water Quantity and Quality* section of this chapter.

The potential reduction in base flow would not have a measurable effect on the amount of available foraging habitat for wintering and migrating bald eagles. Potential impacts would also be minimized because: 1) low numbers of bald eagles typically winter within the hydrologic study area (two to six bald eagles within each of Rock, Maggie, and Boulder creeks sub-basins); 2) wintering and migrating bald eagles use both upland and open water areas for foraging; 3) no drawdown effects are anticipated for the Willow Creek Reservoir, a prominent site for bald eagles; and 4) no known communal or historic roost sites occur within the hydrologic study area (i.e., area of potential groundwater drawdown) (BLM 2000a).

Surface water reductions within occupied LCT habitat could reduce aquatic habitat that supports LCT populations. A reduction of habitat quality or areal extent could result in decreased numbers of this species. However, the majority of occupied habitat in these drainages is located upstream of projected impacts. Therefore, viability of these isolated and self-sustaining LCT populations should be maintained (BLM 2000a), though reductions in available habitat may subject these populations to higher risk, and reduce the potential for recovery.

The modeled maximum extent of groundwater drawdown from cumulative mine dewatering in the Carlin Trend extends into two major drainages and their tributaries that support LCT populations; Maggie Creek and Rock Creek basins (**Figure 4-3**). Surface water impacts are not expected to extend into drainages that contain LCT within the upper Rock Creek Basin and, therefore, LCT populations in those tributaries would not be affected.

The 8-mile segment of Maggie Creek that could be affected by flow reductions, as predicted by cumulative hydrologic models, support individual LCT in scattered locations; but as of 2000, did not support a self-sustaining population. Flow reductions in this segment, however, could reduce the possibility of genetic interchange between existing populations in the basin (BLM 2000a). Impacts to surface water flow could last for about 250 years to reach equilibrium in the vicinity of the Leeville Project after cessation of dewatering in the Carlin Trend (BLM 2000a).

Main tributaries to Maggie Creek that contain LCT and are within the predicted cumulative cone of depression include portions of Coyote, Little Jack, and Beaver creeks. Genetic interchange among these populations and populations in Maggie Creek is limited by migration barriers (e.g., perched culverts) and lack of flow in the lower reaches of these streams. Consequently, individual populations are reproducing but remain isolated from populations in Maggie Creek as well as adjacent streams (AATA 1997; BLM 2000a, 2000c). Flow reductions in these reaches could further reduce potential for genetic interchange among these populations.

BLM (2000a) reported that sensitive bat species would also be adversely affected by cumulative dewatering activities in the Carlin Trend through degradation of foraging habitat associated with wetlands and riparian areas. Impacts to bats associated with the loss of springs, seeps, and stream reaches and associated riparian vegetation would be directly correlated with the magnitude of loss or alteration of these features. Newmont has committed to augment flow in springs, seeps, and streams as specified in the SOAP Mitigation and Monitoring Plan (BLM 1993b). Newmont has implemented a successful riparian restoration project that has improved riparian habitat and stream flows in the Maggie Creek drainage, improving bat foraging habitat (BLM 2000c).

Potential alteration or loss of springs, seeps, and riparian areas due to dewatering may reduce potential prey and impact golden eagles and ferruginous hawks through incremental loss of forage. Newmont has implemented a successful riparian restoration project that has improved riparian habitat and stream flows in the Maggie Creek drainage, improving golden eagle and ferruginous hawk foraging habitat over the short-term.

Potential long-term adverse impacts to northern goshawks could result from reduction or loss of upland and riparian habitats associated with perennial water sources. The majority of these areas, however, would not be impacted by the Project, including impacts from mine dewatering and drawdown. Possible impacts to nesting and foraging goshawks would be limited to upland and/or riparian areas that support suitable trees and vegetation for nesting and prey.

Potential impacts to springs, seeps, and stream reaches could potentially affect burrowing owls if they are dependent upon open water, which has not been documented. Potential impacts are expected to be minor.

Although sage grouse would not be affected by dewatering activities, loss of sagebrush habitat from mine development, wildfires, removal of sagebrush with herbicides, and livestock trampling and grazing are cumulatively interacting to reduce nesting, foraging, and brood-rearing habitat within the Carlin Trend. Throughout the range of the sage grouse, populations are generally declining, and populations are being lost from formerly occupied habitat. Loss or degradation of sage grouse habitat associated with the Leeville Project are expected to be minor, and would not substantially reduce local or regional sage grouse populations.

Columbia spotted frogs have not been documented within the predicted cumulative cone of depression associated with mine dewatering in the Carlin Trend. However, populations of spotted frogs have been found in tributaries to Maggie Creek whose headwaters lie within the cumulative cone of depression.

California floaters have been documented at the margin of the predicted cumulative cone of depression resulting from mine dewatering in the Carlin Trend. These locations are located along Maggie Creek (**Figure 4-3**).

Springsnails have been documented in six springs in upper Antelope Creek subbasin. These springs occur within the predicted cumulative cone of depression associated with mine dewatering in the Carlin Trend.

Potential Monitoring and Mitigation Measures

Appendix A of the Final EIS for Newmont's South Operations Area Project (BLM 1993a) is Newmont's Mitigation Plan for that project. This plan is currently being updated to address potential impacts associated with the South Operations Area Project Amendment. Surface water and groundwater monitoring plans and conditions that would trigger augmentation are described in the Maggie Creek Watershed Restoration Project document. A number of springs, seeps, and stream reaches that include those potentially impacted by dewatering from the Leeville Project, are monitored quarterly. If groundwater levels fall more than ten feet below the lowest level measured during the baseline year (1993) Newmont will initiate, within 14 days, consultation with BLM concerning possible augmentation of the spring group affected, and will increase monitoring to monthly. Other stipulations are described in the Mitigation Plan. Barrick also has a mitigation plan that includes monitoring a number of springs, seeps, and stream reaches. Some of these fall within the possible impact area of the Leeville Project. Details of their monitoring and mitigation plan are presented in Barrick's Draft Supplemental EIS for the Betze Project (BLM 2000b). As of early 2001, an NDOW representative observed that springs, seeps, or stream reaches within the Carlin Trend cumulative impact area have not been adversely impacted enough from drawdown to initiate mitigation and augmentation (Lamp 2001). See Potential Mitigation and Monitoring Plan in *Water Quantity and Quality* section in this chapter.

To minimize potential bald eagle mortality, it would be necessary to either minimize or prevent mule deer mortality on roads (through fencing, traffic speed restrictions, etc.) or require road kills to be immediately reported and removed from the road. During winter months, when eagle numbers reach their peak, mule deer have migrated south to their winter range, and would not pose a problem in areas where haul truck traffic could encounter deer.

Sage grouse populations could be monitored and habitat enhancement/protection measures implemented to preserve or restore sage grouse habitat on the west side of the Tuscarora Range. Habitat enhancement actions could include contribution to habitat restoration projects currently underway and/or a grazing management plan within the T Lazy S Allotment that addresses sage grouse habitat.

Sierra Pacific Power Company power line relocation would be constructed with predatory bird anti-perching devices on crossarms, tops of structures, above the crossing point of cross-braces, and on either side of static wires, as necessary.

Irreversible and Irretrievable Commitment of Resources

With successful reclamation of disturbed areas, there would be no irreversible or irretrievable commitment of resources.

Residual Adverse Effects and Impacts of Mitigation

Successful implementation of mitigation described above would offset impacts. Impacts associated with mitigation activities could include ground disturbance if construction of mitigation measure (pipelines, and wells) necessary to provide flow to streams or springs are implemented.

GRAZING MANAGEMENT

Summary

The proposed mine site and pipeline are located entirely within the T Lazy S grazing allotment although only a portion of the Project area is currently open to grazing. The Proposed Action would result in a direct loss of 36 animal unit months (AUMs) on public land as a result of surface disturbance associated with the Project. Stocking rates on some allotments in the area may be reduced as a result of cumulative impacts of groundwater drawdown, which would reduce water availability, soil moisture, and associated plant productivity and diversity at some sites. Alternative water sources may be developed to compensate for these losses.

Impacts to grazing management resulting from implementation of Alternative A, B, and/or Alternative C would be similar to those described for the Proposed Action.

Direct and Indirect Impacts

Proposed Action

The Leeville Project, which would total 486 acres of disturbance, is located entirely within the T Lazy S Grazing Allotment. Most of the project area (453 acres) is on public land. The allotment is administered by BLM and has been decreasingly available for grazing due to increased mining activity.

The Proposed Action would result in loss of an estimated 36 AUMs on public land in the area currently open to grazing within the Project area. This includes direct loss of approximately 264 acres of surface vegetation in the area currently open to grazing. **Figure 2-**4 shows the current and proposed fencing alignment in the Project area. The associated stocking reduction on the T Lazy S Allotment of 36 AUMs is less than 0.3 percent reduction for that allotment.

Implementing the Leeville Project would not impact additional livestock water sources, but would extend the recovery period after dewatering ceases (see *Water Quantity and Quality* section in this chapter).

Alternative A, B, and C

Impacts to livestock grazing from implementation of Alternatives A, B, and/or C would be similar to those described for the Proposed Action. Reduction in surface disturbance (118 acres) associated with Alternative C would not affect grazing because this area is not currently open to grazing.

No Action

The No Action Alternative would not impact current grazing practices in the area. No ground disturbance would occur and stocking rates would continue at present levels.

Cumulative Impacts

The cumulative impacts area for grazing resources includes all or portions of the T Lazy S Allotment, the Twenty-Five Allotment, Marys Mountain Allotment, and the Carlin Field allotment. Portions of these allotments have previously been excluded from grazing, primarily in response to mining activity.

Reduction or loss of water flow in springs used by livestock resulting from dewatering activities at the Leeville Mine and other mines in the Carlin Trend could result in displacement of livestock and/or concentrating livestock at water sources not affected by dewatering. Sixteen of 28 water sources on the T Lazy S Allotment are potentially affected to some degree by regional groundwater drawdown in the area caused by all dewatering operations in the north Carlin Trend (BLM 2000a).

Groundwater drawdown resulting from mine-related dewatering activities in the area may affect various livestock watering sources, including improved springs, stock wells, springs, seeps, and perennial stream reaches. These impacts could vary from reduced flows to cessation of flow for a period of up to nearly 100 years. These potential impacts however, would not likely result in a reduction of AUMs within the Twenty-Five and Carlin Field allotments.

Increased irrigation within Boulder Valley would likely increase the areal extent of herbaceous wetlands and irrigated hay meadows within and adjacent to the floodplain, forage production and carrying capacity of these areas, and the availability of water for livestock use. Continued infiltration of discharge water into the TS Ranch Reservoir would continue to provide a water source to springs in the Boulder Valley.

Potential Mitigation and Monitoring Measures

Groundwater drawdown has the potential to impact area water sources. These sources should be monitored to evaluate impacts of drawdown on flow from these sources. Measurable reduction in flow would be compensated for by providing water in the same vicinity by alternative methods (water development or augmentation methodologies).

Shifts in livestock grazing habits resulting from dewatered springs has potential to impact other area water sources. Consequently, livestock distribution and allotment use patterns should be monitored. Development of new water sources in impacted areas could offset impacts.

Most areas disturbed by mine-related activities would be revegetated to restore and mitigate for vegetation lost.

Irreversible and Irretrievable Commitment of Resources

Grazing on mine-related disturbance areas would be lost until revegetation efforts and forage production are comparable to pre-mining levels associated with adjacent land.

Residual Adverse Effects and Impacts of Mitigation

Potential loss of available water sources resulting from groundwater drawdown may result in long-term reductions in carrying capacity on some allotments. Mitigation activities (e.g., fence construction, water development) would produce short-term local disturbance. Operation and maintenance of developed mitigation would consume energy and produce intermittent local disturbance.

RECREATION AND WILDERNESS

Summary

Dispersed recreation opportunities in the vicinity of the proposed Leeville Project have been restricted since the early 1980s due to intensified mining and exploration activities in the Carlin Trend. Addition of the Leeville Project would result in fewer acres available for recreational activities during operation and after cessation of mining until reclamation is complete. Most of the work force for facility construction and mining would be drawn from the local labor pool; consequently, impacts to existing campgrounds and other area recreational opportunities are expected to be minimal relative to existing conditions. Wilderness areas would not be impacted by the Proposed Action or Alternative A, B, and/or C.

Direct and Indirect Impacts

Proposed Action

Recreation

The Proposed Action, including construction of the mine dewatering system pipeline, would result in the incremental disturbance of 486 acres (453 public and 33 private). This area would not be available for recreation until mining and reclamation are completed. The Leeville Project area is not intensively used for recreation due to extensive mining and exploration activities in the surrounding area. Consequently, public access has been restricted for safety and security reasons. In addition, land within the proposed project vicinity does not offer unique outdoor recreation opportunities. Portions of the study area outside of the Carlin Trend active mining district, including land within BLM's Elko, and Winnemucca districts contain large areas of similar land available to the public for dispersed recreation.

Construction of mine facilities would require about 4 years. The labor force for mining operations is expected to peak at about 400 employees. Due to area mine closures and/or cutbacks, existing local labor force would be sufficient to provide workers during construction and mining phases of the project. Regional recreation opportunities, including campgrounds and other facilities, would be minimally impacted.

During the life of the Leeville Project and prior to completion of reclamation, the mine site and immediate surrounding area would be unavailable for hunting. Hunting opportunities in the area would be further reduced because big game species, such as pronghorn antelope and mule deer, would likely use alternate winter range and migration routes. Hunting opportunities outside the immediate project area and the North Operations Area may be adversely affected by additional mining activity and effects of localized dewatering on big game and game bird habitat. These impacts are discussed further in the *Cumulative Impacts* section of this chapter.

Wilderness

The nearest wilderness is over 50 miles away and the closest Wilderness Study Area (WSA) is over 25 miles away. Neither the wilderness or the WSA is expected to be directly impacted by the Leeville Project although high-intensity lighting associated with mining activity could affect the sense of solitude experienced by visitors to the WSA when the glow is visible. Glow from the Leeville Project would not be discernible from other existing light sources in the North Operations Area.

Alternatives A, B, and C

Effects on recreation and wilderness resources from implementation of Alternative A, B, and/or C would be similar to those described for the Proposed Action.

No Action Alternative

Under the No Action Alternative no additional disturbance to private or public land or direct impacts to recreation and wilderness resources would occur.

Cumulative Impacts

The cumulative impacts area evaluated for recreation and wilderness values includes northeastern Nevada. The gradual but continuous expansion of mining activities along the Carlin Trend would result in less area available for dispersed recreational activity. Any increase in population associated with expanding mining activity would result in more demand for recreation on public land. A Cumulative Impact Analysis report (BLM 2000a) predicted displacement or loss of animals, including big game species, upland game birds, and waterfowl in habitat located in areas affected by combined dewatering operations. These areas include riparian habitat, mule deer and pronghorn antelope seasonal ranges and transitional ranges, and to a lesser extent, big horn sheep range. These areas are within the predicted maximum drawdown area, which is illustrated in **Figure 4-3.** Decreased game animal density in areas where surface water sources are reduced or eliminated would diminish the appeal of the area to hunters.

Although the nearest wilderness area is over 50 miles away, increased night lighting associated with the combined effects of the various mining projects in the Carlin Trend would affect a person's sense of wilderness experience.

Potential Mitigation and Monitoring Measures

No mitigation or monitoring measures for recreation or wilderness have been developed by the BLM.

Irreversible and Irretrievable Commitment of Resources

Newmont has developed a reclamation plan in accordance with BLM and NDEP regulations to address disturbances associated with the Leeville Project. The objectives for reclamation are to support post-mining land use, including dispersed recreation activities. According to the Plan of Operations (Newmont 1997a), a portion of the rock faces associated with surface support facilities would not be reclaimed. Pre-mining land uses are expected to resume.

No irretrievable or irreversible impacts to wilderness areas or recreational uses within the study area are expected as a result of the proposed Project.

Residual Adverse Effects and Impacts of Mitigation

Residual effects on recreation resources may include withdrawal of land not reclaimed for future recreation opportunities or enhancements. The Proposed Action adds to the number of disturbed acreage in the vicinity; however, all but a small portion of the total disturbance would be reclaimed. No residual adverse impacts to wilderness areas are expected as a result of the Proposed Action.

ACCESS AND LAND USE

Summary

During the last two decades, land use in the Leeville Project area has changed from ranching and grazing to predominantly mining. Since the early 1980s, access to rangeland in the project area has been restricted due to concentrated mine exploration and development in the region. The Proposed Action would not affect existing rights-of-way for Barrick's communication site and access road, and Sierra Pacific Power Company's powerline along the North-South Haul Road. An amendment to an existing Sierra Pacific Power Company right-of-way allowing rerouting of approximately 3800 feet of existing powerline through the proposed mine area would be submitted to BLM for approval. Impacts to land use and access resulting from implementation of Alternative A, B, and/or C would be the same as those described for the Proposed Action.

Direct and Indirect Impacts

Proposed Action

Existing rights-of-way for Barrick's communication site (N-54682) and access road (N-48045), and Sierra Pacific Power Company powerline along the North-South Haul Road (N-46957) would not be affected by the Proposed Action. Rerouting approximately 3,800 feet of an existing Sierra Pacific Power Company powerline within the proposed mine area would require an amendment to right-of-way N-47775. Newmont would submit an application for amendment to BLM for approval. Existing access into the Project area is controlled by Newmont and Barrick and would not be affected by the Proposed Action.

Alternatives A, B, and C

Direct and indirect impacts to land use and access from implementation of Alternative A, B, and/or C would be similar to those described under the Proposed Action. Impacts to public access within the Project area and immediate vicinity would be similar to those described for the Proposed Action.

No Action Alternative

The No Action Alternative would result in no additional impacts to land use and access.

Cumulative Impacts

The cumulative impacts geographic area evaluated for land use and access encompasses roads and public land access in and adjacent to the Carlin Trend extending from the Emigrant Springs Project area to the Hollister Mine.

As mining continues to develop along the Carlin Trend, more land would be removed from public access for use by mining activities. Water uses would be affected where mine dewatering causes significant changes in groundwater levels, surface water flow, and/or water quality.

With the exception of rock faces, highwalls, and open pits, restoration of land surface disturbed by mining to post-mining land uses would eventually result in reestablishing land use and access similar to pre-mining levels.

Potential Mitigation and Monitoring Measures

No mitigation or monitoring for land use or access has been developed by BLM.

Irreversible and Irretrievable Commitment of Resources

Except for portions of rock faces near the surface support facilities, all disturbed areas would be
reclaimed. Pre-mine land uses including wildlife habitat, dispersed recreation, and grazing, are expected to resume following reclamation.

Residual Adverse Effects and Impacts of Mitigation

No residual adverse effects to land use activities are expected following reclamation of the Leeville Project area. Portions of the rock faces that are not reclaimed may restrict, to a minor degree, vehicle and foot access to a limited area at the mine site.

NOISE

Summary

The Leeville Project would result in an increase and or continuation of current noise levels generated by mining and ore-processing activities in Newmont's North Operations Area and South Operations Area. Noise generated would not impact residential areas. Noise impacts resulting from implementation of Alternative A, and/or B would be the same as those described for the Proposed Action. Noise would be generated during backfilling of shafts under Alternative C.

Direct and Indirect Impacts

Proposed Action

The major sources of noise from the Leeville Project would be loading of waste rock and ore, and truck haulage. Surface equipment including haul trucks and loaders currently used in Newmont's mining operations would be used at the Leeville Project. Noise generated from the Proposed Action would not impact residential areas. Potential impacts of noise on wildlife are discussed in the *Terrestrial Wildlife* section of this chapter.

Alternatives A, and B

Under Alternative A, B, and C, no significant change in the degree of noise is expected to occur from normal mining operations or from pre-mining construction activities. Since the Leeville Project's life-of-mine would extend beyond the projected life-of-mines for current mining operations in the vicinity, noise from the Leeville Project would result in extending the duration of noise generation in the Carlin Trend.

Alternative C

Noise would be generated during backfilling of shafts under Alternative C.

No Action Alternative

Under the No Action Alternative, impacts from noise would not change from current levels.

Cumulative Impacts

As mining continues to develop along the Carlin Trend, noise would continue to be generated from mining and processing activities as well as changes in the location of noise sources through 2020.

Potential Mitigation and Monitoring Measures

No mitigation or monitoring measures for noise beyond those required by the Mining Safety and Health Administration (MSHA) have been identified by the BLM.

Irreversible and Irretrievable Commitment of Resources

No resource would be irreversibly or irretrievably impacted by noise generated from the Leeville Project.

Residual Adverse Effects and Impacts of Mitigation

There would be no residual adverse effects on the environment from the noise generated during mining and ore-processing operations. When mining activity ceases, anthropogenic noise would be reduced to low levels associated with reclamation (recontouring and seeding) and then cease altogether.

VISUAL RESOURCES

Summary

Visual impacts of the Proposed Action and Alternatives were analyzed using procedures set forth in the Visual Resource Contrast Rating Handbook (BLM 1986b). Changes in landscape from the Proposed Action and Alternatives are compared with the characteristic landscape to determine the degree of contrast in form, line, color, and texture. If the degree of contrast does not meet the Visual Resource Management (VRM) System objectives, the Project should be redesigned or mitigation measures proposed. As noted in Chapter 3, most of the Project site is located on VRM class IV land, which allows the greatest degree of modification of the landscape by management activities. Implementation of Alternative A would eliminate the canal segment of the water discharge pipeline system. Reclamation of the pipeline corridor would eliminate visual contrast associated with an open canal. Impacts resulting from implementation of Alternative B and/or C would be similar to those described for the Proposed Action.

Direct and Indirect Impacts

Proposed Action

The primary impact of the Proposed Action would be large-scale modification of landforms. Angular, blocky forms and horizontal lines would create moderate contrasts with the natural rounded, rolling hills and ridges of the characteristic landscape. These contrasts would be weaker where existing facilities would be expanded. KOP locations used to evaluate visual impacts and VRM class boundaries are shown on **Figure 3-18**.

Land clearing and construction of waste rock disposal facilities would expose soil and rock material in a variety of colors ranging from light grayish tan to reddish tan to very dark gray. Contrast between these colors and those existing in the landscape would range from moderate in bright sunlight and when front lighted, to weak in overcast conditions and when back lighted.

Clearing vegetation from mine facility areas would create weak to moderate color contrasts with the existing landscape. New lines would be introduced delineating edges of cleared areas and some change in texture would be seen, but overall contrast would be weak. Visual impacts from new structures would be small when compared with visually dominant waste rock disposal sites and mine pits in adjacent mine areas.

When viewed from KOP1, the Proposed Action would offer weak contrasts with the existing landscape (**Figure 4-5**). The waste rock facility would dominate the view. Much of the topsoil stockpile and part of the refractory ore stockpile areas would be obscured by the waste rock disposal facility. Bold, angular forms, vivid color hues, and rough textures would be introduced by the Proposed Action. These would be similar in appearance to existing, adjacent mining facilities visible from KOP1.

From KOP2, the Turf ventilation shaft area and headframe would be visible in the foreground, creating moderate to strong contrasts in form, line, and color (**Figure 4-5**). The refractory ore stockpile and waste rock disposal facility would introduce weak to moderate contrasts in form, line and color with the existing landscape. Bold, trapezoidal forms and horizontal lines would be introduced by the waste rock disposal facility, creating weak to moderate contrasts with the existing landscape. Exposure of unweathered soil and rock would create moderate contrasts in color with the characteristic landscape.

All facilities associated with the Proposed Action would be visible in the middleground and background from KOP3 (**Figure 4-5**). The waste rock disposal facility and the refractory ore stockpile would introduce blocky, trapezoidal forms which would create moderate contrasts with the existing landscape. To the east, views of headframe structures would offer weak to moderate contrasts in form, line, and color. The dewatering pipeline corridor would be visible in the distance to the west. This facility would introduce weak contrasts in line and color with the existing landscape. Visual impacts of the Proposed Action could be perceived as an extension of the existing mining operations adjacent to the Project site.

Reclamation would reduce visual contrast associated with the Proposed Action (**Figure 4-6**). Residual visual impacts, however would be permanent.

Alternative A

Elimination of the canal segment of the water discharge pipeline system and reclamation of the pipeline corridor would eliminate visual impacts as seen from KOP1 and KOP2 (**Figure 4-5**). Major structures offering moderate to strong contrasts with the existing landscape would be eliminated.

Alternative B and/or C

Implementation of Alternative B and/or C would have no effect on the extent of visual impacts of the Proposed Action.

No Action Alternative

Under this alternative no visual impacts would occur at the Leeville Mine site beyond those already present.

Cumulative Impacts

Reclamation measures are required and would occur on current and future mining activities in the Carlin Trend. However, major elements of certain mining facilities would remain, including pit highwalls and earth-fill structures. Visual contrasts in form, line, and color would remain in the post-mining landscape.

VRM Class IV allows management activities that result in major modification to the character of the landscape. Impacts on visual resources from reasonably foreseeable mining activities can be minimized, but not eliminated, through reclamation measures. To continue to meet VRM Class IV objectives, all feasible measures should be taken to minimize visual impacts. It is possible to regrade earthen structures to reflect existing forms, lines, colors, and textures. Recla-mation grading can achieve a stable post-mining configuration by rounding angular features and flattening side slopes. Modifying the flat top surface of earthen structures and developing variable sideslopes can help reduce visual contrasts created by horizontal lines and trapezoidal forms.

Potential Mitigation and Monitoring Measures

Mitigation measures have been developed to minimize visual impacts. The objective is to reduce visual contrasts based on three concepts: (1) siting of facilities in less visible areas; (2) minimizing disturbance; and (3) repeating basic elements of form, line, color, and texture. Photographic simulations of the reclaimed Leeville site as seen from KOP1, KOP2, and KOP3 are shown in **Figure 4-6.** In addition to measures included in the Proposed Action, the following measures could be applied to minimize visual impacts of the Proposed Action and alternatives:

- Slope gradients on embankments (between 3H:1V and 2.3H:1V) could be varied to create diversity of form and reflect the naturally rolling, rounded forms of the existing topography;

- Edges of embankments could be rounded to reduce the angular appearance and soften edges;

- Clearly defined construction limits should be established. Construction limits should use irregular shapes that reflect existing forms and patterns;

- Revegetation should be planned so colors and textures blend with undisturbed lands;

- Visual contrast of structures with natural forms could be minimized by using colors that blend with the land rather than the sky and using finishes with low levels of reflectivity; and

- Painting structures a slightly darker color than the surrounding landscape could compensate for the effects of shade and shadow.

Figure 4-5

blank

Figure 4-6

blank

Irreversible and Irretrievable Commitment of Resources

An irretrievable commitment of visual resources would occur during construction and active mining period until reclamation is successful. Impacts on visual resources would be reduced through implementation of reclamation and mitigation measures. Unreclaimed rock faces would represent an irreversible commitment of resources.

Residual Adverse Effects and Impacts of Mitigation

Following successful reclamation, the waste rock disposal facility would be the most noticeable residual adverse effect of the Proposed Action **Figure 4-6**). Weak contrasts in form, line and color could remain. Weak contrasts would result from the prismoidal forms and straight lines of the reclaimed waste rock disposal embankments. Finer and more uniform soil in this area would also create weak contrasts in texture with the existing landscape. Rock faces associated with the Leeville Project disturbances adjacent to Rodeo Creek would remain visible after reclamation as weak contrast associated with straight lines and color.

Implementation of mitigation measures would further reduce visual impacts. No adverse impacts are anticipated to result from mitigation.

CULTURAL RESOURCES

Summary

The Area of Potential Effect associated with the Leeville Project takes into consideration effects to properties eligible for listing on the National Register of Historic Places. For purposes of this assessment the Area of Potential Effect has been divided into two sub-areas. The Area of Direct Effect is the area where potential surface disturbance or occupancy would occur as described in the Proposed Action and Alternatives. The Surrounding Area of Effect lies outside the Area of Direct Effect and may be subject to impact although no surface disturbance is proposed ***(Figure 3-20)****. For example, some resources may be impacted due to introduction of visual or audible intrusions.*

Implementation of the Proposed Action or Alternatives would not impact any property determined eligible or potentially eligible to the National Register of Historic Places. The Proposed Action and Alternatives would result in the loss of cultural resources that are not eligible to the National Register of Historic Places. However, these properties have been recorded to BLM standards and that site information has been integrated into local and statewide data repositories.

Direct and Indirect Impacts

Proposed Action

Thirty-one cultural resources are located within the Area of Direct Effect, none of which are eligible or potentially eligible to the National Register of Historic Places. One site (CrNV-01-10801), a multi-component prehistoric site located in the Surrounding Area of Effect near the proposed dewatering pipeline and canal system, has been determined eligible to the National Register based on Criterion D. Construction of the proposed pipeline and canal system would not disturb this site. No impact would occur to this property as a result of the Proposed Action.

Some 306 cultural resources have been identified in the Surrounding Area of Effect. The BLM has determined that 22 of these resources are eligible for listing on the National Register; one additional resource is identified that “may be eligible.” Of the eligible and potentially eligible properties, two are considered significant based on a National Register eligibility criterion other than D. An historic period mine complex (CrNV-01-10842), and, a historic period debris scatter (CrNV-01-12466), both are considered eligible based on criteria A and D.

CrNV-01-10842 is a large complex of placer mining sites that extend over a mile along a drainage on the east side of the Tuscarora Mountains. Most historic period activities occurred along drainage bottoms, but some isolated prospect features are located at the head of a drainage or canyon that affords a view to the west (into the Project area). Some Project facilities would be visible from those isolated prospects. The southeast ventilation shaft would be about one-half mile from the nearest such prospect, while other visible Project elements (ore and aggregate stockpiles) would be more distant (about 2 miles away). Facilities associated with the production shaft would not be visible due to an intervening hill. Existing unimproved roads and an electrical transmission line are located between the isolated prospects and the proposed Project area. Therefore, it is unlikely the Proposed Action would have any additional impact to the setting or general integrity of CrNV-01-10842 that has not occurred previously.

CrNV-01-12466 is also located in a drainage bottom along the east slope of the Tuscarora Mountains. The property is about 2 miles from the nearest proposed Project facility. None of the proposed Project facilities would be visible from CrNV-01-12466. Therefore, the Proposed Action would not have an impact to the setting or general integrity of CrNV-01-12466.

Based on currently available resource information, the Proposed Action would not have the potential to impact the integrity of National Register eligible properties located in the Surrounding Area of Effect.

Alternatives A, B, and C

Impacts resulting from implementation of Alternative A, B, and/or C would be similar in nature and magnitude to those described for the Proposed Action.

No Action Alternative

Impacts on Cultural Resources resulting from implementation of the No Action Alternative would be similar to existing conditions in the Leeville Project area.

Cumulative Impacts

Activities associated with the Leeville Project would result in an improved level of access into the Project area and the surrounding area as well. Improved access and increased traffic volumes would contribute to increased activity (intentional and casual) at cultural resource locations. There is a potential for impacts to occur to resources due to these activities.

Potential Mitigation and Monitoring Measures

The Proposed Action would not have a direct impact on National Register eligible properties located in the Area of Direct Effect, nor indirect impact on eligible properties located in the Surrounding Area of Effect.

Irreversible and Irretrievable Commitment of Resources

The Proposed Action and Alternatives would result in the loss of 31 cultural resources that are not National Register eligible. Their loss would constitute an irreversible and an irretrievable commitment of a resource. However, these resources have been recorded to BLM standards and site information has been integrated into local and statewide data repositories.

Residual Adverse Effects and Impacts of Mitigation

There would be no residual adverse effect to cultural resources as a result of the Proposed Action and Alternatives.

NATIVE AMERICAN RELIGIOUS CONCERNS

Summary

Consultation with the Newe/Western Shoshone occurred in two phases. Phase I involved consultation concerning proposed areas of disturbance associated with the Leeville Project. The Newe/Western Shoshone did not identify any religious or traditional cultural properties within the proposed Project area. Phase II of the consultation concerned potential cumulative impacts to Newe/Western Shoshone religious and traditional areas that could occur as a result of the cumulative effects of groundwater dewatering.

Implementation of the Proposed Action or Alternatives would have no direct or indirect impacts on Newe/Western Shoshone traditional cultural values, practices, properties, or human remains.

Direct and Indirect Impacts

Proposed Action

Consultation between BLM and the Newe/Shoshone has been ongoing since May 1997 (see **Appendix A**). There have been no religious or traditional values, practices, human remains, or cultural items identified in the Project area as a result of consultation.

Deaver (1993) made the following conclusions in an ethnographic report regarding the general region:

- There are no apparent uses of the direct impact area for spiritual or ceremonial purposes;
- Cultural properties within the area of the proposed project do not appear to qualify as traditional cultural properties; and
- The Leeville Project area is within the traditional territory of the Newe/Western Shoshone, and within the boundary of land covered by the Treaty of Ruby Valley. Although specific properties or areas of concern have not been identified within the Project area, many Newe/Western Shoshone traditionalists maintain that they never ceded their traditional land and that they retain jurisdiction over public domain in this area. In the traditional worldview, disturbances such as mining disrupt the flow of *Puha* (spiritual power) and lead to a dissipation of spirit life and degradation of sacred spring water. Some traditional values associated with the land are irreplaceable. However, reintroducing native plants and animals as part of the reclamation plan can reduce the magnitude of that loss.

Alternatives A, B, and C

Impacts resulting from implementation of Alternative A, B, and/or C would be similar in nature and magnitude to those described for the Proposed Action.

No Action Alternative

Selection of the No Action Alternative would result in no further direct or indirect impacts on Native American religious or traditional values, practices, properties, human remains or cultural items.

Cumulative Impacts

The Proposed Action would not have a direct impact on Native American religious or traditional values, practices, human remains, or cultural items. However, some Newe/Western Shoshone have expressed a concern that cumulative impacts may occur to their spiritual life and cosmology. The Proposed Action would contribute to groundwater drawdown over some area, potentially impacting stream, spring, and seep flows. Associated changes would occur to vegetation patterns and wildlife distribution. Such changes, individually and collectively, could impact the integrity of power spots, disrupt the flow of spiritual power (*Puha*), and cause the displacement of spirits (e.g., little men and water babies). Any such impact would limit the potential of Newe/Western Shoshone to participate in traditional religious activities. The potential for such an effect is of concern to some Newe/Western Shoshone because impacts associated with groundwater drawdown would be interwoven, and the resultant disruption of spirit forces could occur over a wide area.

Given that religious or traditional values, practices, human remains, or cultural items were not identified by the Newe/Western Shoshone in the Project area, and the Project is predicted to have limited direct impact on groundwater conditions, BLM has determined the potential for a cumulative impact to Native American traditional values is minimal. Effects resulting from mine dewatering would be temporary. Models indicate a 90 percent recovery of the water table about 30 years following cessation of dewatering associated with the Leeville Project. Springs and seeps near the Project affected by dewatering should begin to recover once dewatering operations cease.

Potential Mitigation and Monitoring Measures

No direct or indirect effects on Newe/Western Shoshone traditional cultural values, practices, properties, or human remains are anticipated in the Leeville Project area as a result of the Proposed Action or Alternatives. Therefore, mitigation or monitoring measures are not proposed.

Irreversible and Irretrievable Commitment of Resources

Consultation with the Newe/Western Shoshone has not identified specific spiritual or religious resources in the Project area. As a result, the Proposed Action and Alternatives would not cause an irreversible or irretrievable commitment of any such resource. Impacts to identified traditional cultural properties would not occur due to the Proposed Action or Alternatives.

Residual Adverse Effects and Impacts of Mitigation

Consultation with the Newe/Western Shoshone has not identified specific spiritual or religious resources in the Project area. As a result, no residual effects would occur to such resources as a result of the Proposed Action or Alternatives.

SOCIAL AND ECONOMIC RESOURCES

Summary

Temporary contract workers would be hired for the construction phase of the Leeville Project. Approximately 300 construction workers would be employed during Year 1, decreasing to 200 in Year 2, 150 in Year 3, 100 in Year 4, and 50 by Year 5 (Coxon 1997). Newmont anticipates 400 workers would be needed during the operational phase of the Project. A majority of operational personnel would be hired from the existing mine-related work force in the Carlin Trend.

Positive impacts that would occur under the Proposed Action and Alternatives would be continued direct employment in the mining industry and secondary employment in the retail and service sectors in the study area; income generated from wages earned by workers at the Leeville Project and by secondary job employees within the study area communities; and property taxes and net proceeds of mining taxes paid by Newmont for the Leeville mining operation collected by local and state jurisdictions. Negative impacts would be minimal because only a small number of construction and operational workers are expected to be hired outside the local labor area. The low market price of gold over the past year has resulted in a slow-down of growth in the area and, in turn, more housing is available in the area and community services are less stressed.

Under the No Action Alternative, the Leeville Project would not be approved. Since most of the work force for the Leeville Project would come from the existing mine-related work force in the Carlin Trend, negative impacts under the No Action Alternative would include increased unemployment, reduced wages spent in the local economy, decreased revenues to local and state jurisdictions, increased stress on public assistance programs, and decreased quality-of-life of some residents.

Direct and Indirect Impacts

Proposed Action

Impacts to socioeconomic resources occur if a large number of workers and their families move into the study area as a result of jobs either directly or indirectly created by mine development and operation. Since a relatively low number of employees outside the study area would be needed for construction and operation activities, few people are expected to move into the area due to the Leeville Project. Therefore, negative impacts to socioeconomic resources such as community services, housing, and social well-being would be minimal.

Economic impacts during operational phases of the project would include continued employment in the mining industry and secondary jobs in retail and service sectors. Most property taxes and net proceeds of mining taxes would be paid to Eureka County, whereas most sales tax revenue would accrue to Elko County. Commercial and resi-dential development induced by mine expansion would increase revenue from property and sales taxes. Opportunities generated by construction and operation of the proposed Leeville Project would positively affect quality-of-life for workers and their families.

Dewatering activities associated with Leeville Project would result in removal of 360,000 acre-feet of groundwater from the water resource. These activities are predicted to have a slight direct effect (0.05 cfs) in reducing base flow conditions in a portion of Beaver Creek. Leeville Project dewatering would also extend the duration of dewatering and would delay recovery of existing cones-of-depression in the Carlin Trend.

Predicted reductions in groundwater levels as a result of the Proposed Action would not directly impact stockwater sources, irrigation practices, and other commercial and individual activity in the long-term.

Alternatives A, B, and C

Impacts on socioeconomic resources in the study area under Alternative A, B, and/or C would be similar to those described for the Proposed Action.

No Action Alternative

Negative socioeconomic impacts under the No Action Alternative, due to decreased mining employment, would include increased unemployment, reduced wages spent in the local economy, decreased revenues to local and state jurisdictions, increased stress on public assis-tance programs, and decreased quality-of-life of some residents. Less stress on community services would be a positive impact under the No Action Alternative.

Cumulative Impacts

The socioeconomic cumulative impacts study area includes areas potentially impacted by mine water management activities in the Carlin Trend and other activities that discharge or consume water. This study area includes the towns of Carlin, Palisade, and Dunphy, Nevada and the Humboldt River Basin (downstream to the Humboldt Sink) (BLM 2000a).

Lowered groundwater levels in the Carlin Trend due to continued and expanded dewatering activities at Betze/Post, Gold Quarry, and Leeville mines could affect domestic, irrigation, livestock, industrial, and/or commercial water uses. Decreased water levels may impose additional costs to well owners for increased costs associated with deepening an existing well, drilling a new well, and purchase of new pumps.

Reduced flow in springs resulting from the groundwater cone of depression could adversely affect the availability of water for livestock and wildlife. This would result in socioeconomic impacts to livestock owners and reduced econ-omic benefits derived from wildlife-associated recreation in the area. If the availability of stock water is reduced, grazing permittees may need to locate other pastures for livestock grazing and/or decrease livestock numbers (BLM 2000a). Decreased flow in springs that support the domestic water supply of the town Carlin also could be impacted by increased dewatering in the Carlin Trend.

Irrigation and livestock watering are the primary water uses in the Humboldt River Basin. If discharge of additional mine water to the over-appropriated Humboldt River is authorized by the State Water Engineer, it could have a temporary beneficial effect on irrigation use by water right holders in the basin. There is a possibility that increased flow may cause more water to be in contact with irrigation structures on a year-round basis, causing more damage to structures and making repairs to structures more difficult. After cessation of mining, flow in the Humboldt River would decline to below pre-mining conditions, gradually recovering over a period of more than 100 years. Potential reductions in base flow of the river would impact agricultural operations, especially during low-flow periods, by limiting late season irrigation and livestock watering.

In spite of recent downturn in the value of gold, a construction work force remains located in Elko and Eureka counties. Depending on timing of construction activities at the proposed Leeville Project and other new mine or mine expansion developments, it may be possible for the existing construction work force to satisfy construction labor demands of these projects. If construction activities were to occur simultaneously at future projects, substantial numbers of new construction workers may be needed.

Increased numbers of construction workers mov-ing into the area would not create a problem because excess housing is currently available in the Elko area. If in-migration of workers exceeds current housing, stress on local community services and recreation areas could occur.

Potential Mitigation and Monitoring Measures

BLM's Cumulative Impacts Analysis report (BLM 2000a) presents a comprehensive analysis of cumulative impacts resulting from dewatering operations at Leeville, Goldstrike Property and Gold Quarry mines. Section 9.0 of that document provides a qualitative evaluation of potential effects to social and economic conditions from existing and proposed mining operations within the study area. Because of the complex interrelationships of surface and groundwater variables; soil composition, geologic, climatological, and geochemical variables, all of which are influential of hydrologic impacts, it is not possible, with any degree of certainty, to identify the extent or degree to which social and economic impacts might occur. However, mitigation measures discussed in Chapter 3.2 (BLM 2000a), have been designed, specifically, to ameliorate and alleviate potential economic impacts of the Proposed Action. It is, therefore, not expected that any economic losses would be sustained. Potential economic impacts have been identified and are addressed as part of the analysis in Section 9.0 (BLM 2000a). No mitigation or monitoring of social and economic resource impacts beyond those described in the Cumulative Impact Analysis (BLM 2000a) or the Leeville Plan of Operations have been identified.

Irreversible and Irretrievable Commitment of Resources

There would be no irreversible and irretrievable commitment of socioeconomic resources associated with the Leeville Project.

Residual Adverse Effects and Impacts of Mitigation

No residual adverse effects are expected.

ENVIRONMENTAL JUSTICE

SUMMARY

Direct and indirect impacts associated with the Proposed Action and Alternatives would not have a disproportionate affect on minority populations. Two low-income populations have been identified in the study area. Neither population would receive a disproportionate impact from implementation of the Proposed Action and Alternatives.

DIRECT AND INDIRECT IMPACTS

Proposed Action

Direct and indirect impacts associated with the Proposed Action and Alternatives would not have a disproportionate affect on minority populations in the study area.

Two groups are present in the study area that qualify as low-income populations based on EPA guidelines (1998). As of 1990, nearly 40 percent of Whites and all Asians in Census Tract 9516.01 (located north of Carlin along the Eureka/Elko County line) lived below the poverty threshold. They represent disproportionately large populations when compared with the county or the state as a whole.

Impacts associated with the Proposed Action are identified in other sections of this chapter. None of those impacts would be “adverse” since they would not negatively affect human health or cause a significant environmental impact (none would cause an established threshold to be exceeded). Most impacts would be minor, and temporary or incremental in nature. With cessation of mining, most resource conditions are expected to return to pre-mining condition. Based on results of scoping and public meetings, representatives of the White and Asian populations in Census Tract 9516.01 have not expressed a concern that impacts are unacceptable, or above generally accepted norms. Based on these findings, the Proposed Action would not cause environmental justice impacts to low-income populations within Census Tract 9516.01.

Use of an area by minority or low-income populations for subsistence hunting and gathering can be an important consideration during assessment of environmental justice impacts. Data are not present in BLM files that would suggest the Project area has been used by a minority or low-income population in the recent past for procurement of subsistence resources. Further, no such information was developed during Native American consultation activities (see **Appendix A**). As a result, the Proposed Action would not have an affect on subsistence patterns important to a minority or low-income population.

Alternatives A, B, and C

Environmental justice impacts associated with Alternative A, B, and/or C would be the same as those described for the Proposed Action.

No Action Alternative

Impacts relating to environmental justice would not occur under the No Action Alternative.

Cumulative Impacts

The cumulative effects area for environmental justice includes census tracts 9601, 9506, 9507.02, and 9516.01. When viewed in the context of past and reasonably foreseeable projects, there would be no cumulative environmental justice effects as a result of the Proposed Action or Alternatives.

Potential Mitigation And Monitoring Measures

In the absence of identified environmental justice impacts, mitigation is not necessary.

Irreversible and Irretrievable Commitment Of Resources

There would be no irreversible or irretrievable environmental justice impacts as a result of the Proposed Action or Alternatives.

Residual Adverse Effects and Impacts of Mitigation

Implementation of the Proposed Action or alternatives would not result in residual adverse environmental justice effects.

CHAPTER 5

CONSULTATION, COORDINATION, AND PREPARATION

PUBLIC PARTICIPATION SUMMARY

Public participation specific to the Leeville Project is summarized in this chapter. The summary describes the public involvement, identifies persons and organizations contacted during preparation of the EIS, and specifies time frames for accomplishing goals in accordance with 40 CFR 1506.6.

Public involvement in the EIS process includes the necessary steps to identify and address public concerns and needs. The public involvement process assists the agencies in: (1) broadening the information base for decision making; (2) informing the public about the Proposed Action and the potential long-term impacts that could result from the project; and (3) ensuring that public needs are understood by the agencies.

Public participation in the EIS process is required by NEPA at four specific points: the scoping period, review of Draft EIS, review of Final EIS, and receipt of the Record of Decision.

- **Scoping:** The public is provided a 30-day scoping period to disclose potential issues and concerns associated with the Proposed Action. Information obtained by BLM during public scoping is combined with issues identified by the agencies to form the scope of the EIS.

- **Draft EIS Review:** A 60-day Draft EIS review period is initiated by publication of the Notice of Availability for the Draft EIS in the Federal Register. A public hearing will be held in Elko, Nevada during the 60-day comment period.

- **Final EIS Review:** A 30-day Final EIS review period is initiated by publication of the Notice of Availability for the Final EIS in the Federal Register.

- **Record of Decision:** Subsequent to the 30-day review period for the Final EIS, a Record of Decision will be prepared and a Notice of Availability for the Record of Decision will be published in the Federal Register.

IMPLEMENTATION

The public participation process for the Leeville Project EIS is comprised of the following six components:

1. Public Scoping Period and Meetings

Publication of a Notice of Intent (NOI) initiated a public scoping period on August 1, 1997. The NOI summarized the Proposed Action and a determination by BLM that an EIS would be necessary for analysis of the proposal. The news media and public were notified of the public comment period. A news release was sent to nineteen news organizations.

A scoping package that included a project summary and maps were mailed to various agencies, groups, and individuals announcing the scoping period and describing the Proposed Action. Issues that had been identified by the agencies were also included in the mailing.

A formal public scoping meeting was held in Elko, Nevada on August 20, 1997. The scoping meeting was attended by twenty members of the public. No comments were received by BLM during the meeting. The scoping letter was made available at the meeting.

The public scoping period ended on September 2, 1997. During that period the agency received 12 written responses from individuals and organizations.

2. Public Scoping Report

BLM compiled a Public Scoping Report for distribution to interested persons. The Public Scoping Report is available at the BLM Field Office in Elko, Nevada.

3. EIS Mailing List

An EIS mailing list of interested persons was assembled from previous mining-related EIS mailing lists maintained at BLM Field Office in Elko, Nevada. This list is supplemented by addresses on letters received during the scoping period.

4. Distribution of the Draft EIS

The Draft EIS will be distributed as follows:

- A Notice of Availability will be published in the Federal Register specifying dates for the comment period.
- A news release will be provided by the BLM Elko Field Office at the beginning of the 60-day comment period on the Draft EIS. The news release will be submitted to the same news organizations as the initial public scoping announcement.
- The Draft EIS will be distributed to interested parties identified in the updated EIS mailing list.
- Letters received during the public review period for the Draft EIS will be acknowledged such that respondents will know that their comments have been received by BLM.
- A public meeting will be held in Elko, Nevada to obtain comments on the Draft EIS and to answer questions that the public may have regarding the Project or the EIS process. The meeting will take place after publication of the Federal Register Notice. The meeting will be held on April 3, 2002.
- Briefings will be offered for local government representatives.

5. Final EIS Distribution

The Final EIS distribution will be completed after consideration is given to comments received on the Draft EIS. The Final EIS will be released as follows:

- A Notice of Availability will be published in the Federal Register;
- Copies of the Final EIS will be sent to addresses on the mailing list; and,
- A news release will be issued to the same news outlets used for previous project announcements.

6. Record of Decision

The Record of Decision will be distributed to people and organizations identified on the updated project mailing list. A news release will be made to the same news outlets used for previous project announcements.

CRITERIA AND METHODS BY WHICH PUBLIC INPUT IS EVALUATED

Letters and testimony concerning the Draft EIS will be reviewed and evaluated by BLM to determine if information provided in the comments would require a formal response or contain new data that may identify deficiencies in the EIS. Steps would then be initiated to correct such deficiencies and to incorporate information into the Final EIS.

Should changes from the Draft EIS to the Final EIS be deemed significant, BLM will review and evaluate the need to reissue a Draft EIS, prepare a supplemental EIS, or prepare a Final EIS.

Consultation With Others

The following state and federal agencies were consulted during preparation of the EIS:

- Nevada Department of Conservation and Natural Resources
  - Division of Environmental Protection
  - Division of Water Resources
  - Division of Wildlife
  - Nevada Natural Heritage Program
- Nevada Department of Human Resources
- Nevada Department of Water Resources
- Nevada Department of Business and Industry
- Nevada Department of Transportation
- United States Environmental Protection Agency, Region IX
- United States Fish and Wildlife Service
- United States Bureau of Reclamation
- United States Army Corps of Engineers

This page intentionally left blank.

LIST OF PREPARERS AND REVIEWERS

Lead Agency – Bureau of Land Management

Cooperating Agencies

- United States Fish and Wildlife Service;
- Nevada Division of Wildlife; and,
- Eureka County (Social and Economic Resources Only)

Interdisciplinary Team and Technical Specialty

Deb McFarlane-EIS Project Team Leader/Geology, Minerals/Hazardous Materials/Environmental Justice
Janice Stadelman - Asst. Project Leader/Plan Review/Reclamation/Soil
Steve Dondero - Recreation/Visual Resources
Pat Coffin - Wetland/Riparian Zones and Fisheries/Wildlife/T&E
Roger Congdon – Groundwater and Surface Water/Air Resources+
Carol Marchio – Soils
Donna Nyrehn - Grazing/Vegetation
Tom Olsen - Groundwater Modeling
Bob Marchio - Land Use and Access
Bryan Hockett - Cultural Resources/Native American Religious Concerns/Paleontology
Paul Myers – Socioeconomics
Tamara Hawthorne - Wilderness

Newmont Mining Corporation

Dennis Erwin – Project Manager
Paul Pettit – Hydrology Manager

Third Party EIS Contractor and Subcontractors

Maxim Technologies, Inc.

Terry Grotbo – Project Manager
Pat Dunlavy – Asst. Project Manager/Water Resources
Doug Rogness – Physical Sciences Coordinator/Water Resources
Pat Mullen – Biological Sciences Coordinator, Wildlife, Vegetation
Allen Kirk & Mike Ellerd – Geology and Minerals/Paleontology
Joe Murphy – Social Sciences Coordinator/Haz Materials /Land Use and Access/Recreation
Mitch Paulson – Visual Resources
Bonnie Johnson – Document Control

Subcontractors

Joe Elliott (Joe Elliott Ecologist) – Biological Sciences Senior Review
Jeff Johnson (Johnson Wirth Assoc.) – Visual Resources
Leslie Burnside (Harding ESE) – Soil
Diane Lorenzen (Lorenzen Engineering) – Air Quality
Charles Zeier (Harding ESE) – Cultural Resources/Native American Religious Concerns
Dr. Alice Rich (A.A.Rich and Assoc.) – Fisheries
Linda Priest (Northwest Resources Consultants) – Socioeconomics
Dr. Page Herbert – Karst/Fracture Flow/Grouting Expertise

This page intentionally left blank.

MAILING LIST – LEEVILLE PROJECT EIS

LEEVILLE MAILING LIST

Dr. Robert J. Glennon
University of Arizona

Dr. Howard Wilshire
Chairman, Board of Directors

Stan Haye

Rich Haddock

Edward S. Syrjala

Mark Dubois

Mark Sanders

Jaak Daemen, UNR
Dept. of Mining Engineering
Mackay School of Mines

Paul and Valery Pettit

Jim Pond

John Bedrow
Sierra Pacific Power Co.

George Brown

Bill Houston
Land Manager

Trevor Elenbaas

Richard L. Davis

Glenn Lewis

Hugh and Myrtle Coltharp

Roger Flynn
Western Mining Action Project

Dr. Glenn Miller
Mining Chair
Sierra Club, Toiyabe Chapter

Tom Myers
Great Basin Mine Watch

Rod Dwyer
National Mining Association

Katie Fite
Committee for Idaho's High Desert

Rose Strickland
Sierra Club Toiyabe Chapter
Public Lands Committee Chairperson

Merlin McColm
Elko County Conservation Assn.

Pete Hovingh
Intermountain Water Alliance

Mike Baughman
Intertech Services Corporation

Marjorie Sill

Jim Kuipers
Center for Science in Public Participation

Forest Supervisor
Humboldt National Forest

HQ-USAF/LEEV
Environmental Division
Bolling AFB

Honorable John Ensign

Honorable Richard Bryan
United States Senate

Honorable Harry Reid
United States Senate

HQ-USAF/ILEV
Air Force Pentagon

Field Manager
Bureau of Land Management
Las Vegas Field Office

Field Manager
Bureau of Land Management
Winnemucca Field Office

Field Manager
Bureau of Land Management
Carson City Field Office

Interior Department
Washington, D.C.

Honorable Jim Gibbons
United States House of Representatives

Field Manager
Bureau of Land Management
Battle Mountain Field Office

Field Manager
Bureau of Land Management
Ely Field Office

Brenda Whittington
Bureau of Reclamation – USDI

Carol MacDonald
Bureau of Land Management

USEPA Office of Federal Activities
EIS Filing Section

Director
Office of Federal Activities – EPA

Don Peterson
U.S. Fish & Wildlife Service

Kenneth W. Holt, MSEH
Center for Disease Control
Special Groups Group (F16)

Jim Burton
USGS

Bureau of Indian Affairs
Eastern Nevada Agency

Bureau of Reclamation
Environmental Office, D-5150

Calvin Robinson
BLM Nevada State Office

Advisory Council on Historic Preservation

Jake Hoogland
National Park Service

Mr. Richard Gebhart
U.S. Army Corps of Engineers
Reno, NV

U.S. Army Corps of Engineers
Sacramento, CA

Office of Public Affairs
Washington, D.C.

U.S. Fish & Wildlife Service
Project Lead, Endangered Species Office

Vivian Bowie
Office of Environmental Compliance (Eh-42)

Regional Director
Bureau of Reclamation
Sacramento, CA

Lee Campsey
Natural Resources Conservation Svc.
Elko, NV

Regional Director
U.S. Fish & Wildlife Service
Portland, OR

Natural Resources Library
Department of Interior

National Park Service
Washington, D.C.

Marco Haworth
U.S. Fish and Wildlife Service
Reno, NV

Connie Nutt, MS 905
USGS, Denver Federal Center

USDI
Bureau of Reclamation

Mr. Robert Williams
U.S. Fish & Wildlife Service

David Farrel, Cmd-2
Office of Federal Activities
U.S. EPA – Region IX

USDA Cooperative Extension Service
Great Basin College

Phyllis Davis
Office of Environmental Policy and Compliance
USDI

Office of Deputy AS of USAF
Environment, Safety, Occupational Health

Don Sutherland
BIA
Washington, D.C.

USDA
Natural Resources Conservation Service
US Environmental Protection Agency
Las Vegas, NV

US Environmental Protection Agency
Las Vegas, NV

Patricia Port
U.S. D.O.I.
Office of the Secretary
Office of Environmental Policy & Compliance

Dick Wildermann
Minerals Management Service

Wes Wilson
U.S. EPA Region 8

Jeanne Dunn Geselbracht
Office of Federal Activities
U.S. EPA – Region IX

Wayne Bill & Ms. Dallas Smales
Environmental Coordinator
South Fork Band Council
Te-Moak Tribe of Western Shoshone

Larson Bill
Chairman
South Fork Band Council
Te-Moak Tribe of Western Shoshone

James Birchim
Chairman
Yomba Shoshone Tribe

Henry Blackeye
Chairman
Duckwater Shoshone Tribe

Marvin Cota
Chairman
Duck Valley Tribal Council

Carrie Dann
Western Shoshone Defense Project

Fort Hall Indian Reservation
Shoshone-Bannock Tribes
Environmental Coordinator

Maurice Frank-Churchill
Cultural Specialist
Yomba Tribe

Confederated Tribes of the Goshute Reservation
Chairperson

Kathryn M. Griffith
Environmental Specialist
Ely Shoshone Tribe

Bernice A. Lalo
Battle Mountain Bank Council
Te-Moak Tribe of Western Shoshone

Ted Howard
Cultural Preservation Specialist
Shoshone-Paiute Tribes of Duck Valley

Felix Ike
Chairman
Te-Moak Tribe of Western Shoshone

Stanford Knight
Chairman
Battle Mountain Band Council
Te-Moak Tribe of Western Shoshone

Art Kaamasee
Chairman
Ely Shoshone Tribe

Larry Kibby
Consultant/Director
Western Shoshone Historic Preservation Society

Debbie O'Neil
Environmental Coordinator
Duckwater Shoshone Tribe

Jennifer Bell
Environmental Coordinator
Te-Moak Tribe of Western Shoshone

Environmental Coordinator
Wells Band Council
Te-Moak Tribe of Western Shoshone

Fermina Stevens
Chairperson
Elk Band
Te-Moak Tribe of Western Shoshone

Willy Johnny
Chairman
Wells Band
Te-Moak Tribe of Western Shoshone

Dan Randolph
Mineral Policy Center
Durango, CO

Melanie Everhart
Environmental Coordinator
Elko Band Council
Te-Moak Tribe of Western Shoshone

Heather Smith Estes
Lander County Board of Commissioners

Robert Stokes
Elko County Manager

Lander County Commission

Wells Chamber of Commerce

Bob Hatfield
Nevada Association of Counties

City Mayor
Elko, NV

City Manager
Elko, NV

Eureka County Public Land Advisory Commission

Tim Stevenson
Pershing County Extension Agent

Elko Chamber of Commerce

Carlin Planning Board

Linda Bingaman
City Major
Carlin, NV

Chuck Riegel
City of Wells

ECEDA

Elko County Commission
Chairman

Eureka County Commissioners

Public Land Use Planning Commission

Elko City Planning Board

Elko County School District

Great Basin College Library

Mary Elliott, Library Assistant
Nevada State Library

Eureka County Library

Lander County Library

Getchell Library
University of Nevada

Library of Congress

Elko County Library

Salt Lake City Public Library

Linda Newman
Delamare Library/MS 262
University of NV, Las Vegas

James Dickenson Library
University of NV, Las Vegas

White Pine County Library

High Desert Mineral Resources, Inc.

Dave Baker
Newmont Gold Company

Minex Resources, Inc.

John Barber
Dee Gold Mine

Newmont Mining Corporation
Land Department

John Mudge
Newmont Mining Corporation

Bill Upton

Jim Collard
Cortez Gold Mines

Karen Gross
Royal Gold

Paul Mills
Cimbar Performance Minerals
Baroid Drilling Fluids, Inc.

Bob Bryson
Glamis Marigold Mine

Don McLean
Baroid Drilling Fluids, Inc.

Bill Houston
Cameco U.S. Inc.

Anglo Gold

Tri Quest Resources
Southwood Lodge Lake

Bob Ingersoll

Karl Burke
Barrick Goldsrike

Laura Belmont
Battle Mountain Bugle

Elko Daily Free Press

Mike Griswold
Zeda Inc., Horseshoe Ranch

Samual Layton
Adobe Hills Ranch, LLC

Agri Beef Company
I L Ranch

Monte Price
26 Corporation

Jennifer Garrett
Hooper, Wolf & Garrett Families

Laurel Etchegray
Nevada Woolgrowers Association

Dan Gralian
TS Joint Venture

Jon Griggs
Maggie Creek Ranch

Nevada Natural Heritage Program

State Multiple Use Advisory Board

Nevada Division of Forestry

Nevada Land Use Plan Advisory Council

Mike Glock
NDOT District III

Honorable C. Clifton Young

Honorable Kenny C. Guinn
Governor of the State of Nevada

Thomas Fronapfel
NDOT

John Marvel
State Assemblyman District 34

Larry Ravinkar

Lee Taylor

Alan Sweide

Tom Enos

Bennie Hodges
PCWCD

Drury & Francis Thiercof

Margie Lane

John Thomas
SWCA, Inc.

Ted Olsen
Mine Regulations Reporter

John Livermore
Public Resource Assoc.

Bob Edwards
Sierra Pacific Power Co.

Citizens for Mining

Pierre Mousset-Jones, UNR
Department of Mining Engineering – MS 173
Mackay School of Mines

C. Benedict
HIS GeoTrans

Dick Coxon

John Geddie

Mike McFarlane
Great Basin College

Paul Scheidig
Nevada Mining Association

Don Morris

Nevada Cattlemen's Association

John B. Walker
State of Nevada
Office of Community Services

Nevada Division of Wildlife

Dean Rhoads
Northern Nevada Senatorial District

Ray Salisbury

Donald Decker
Century Gold LLC

Mike Malmquist
Parons Behle & Latimer

Dan Johnson

Robert Michna

Alice Baldrica, Deputy
State Historic Preservation Office

Nevada State Clearinghouse
Division of Administration

State Assemblyman John Carpenter
District No. 33, Seat 10

David Gaskin
Bureau of Mining Regulation and Reclamation

Alan Coyner
Nevada Division of Minerals

Miles G. Shaw
NDEP-BMRR

CHAPTER 6
REFERENCES AND GLOSSARIES

REFERENCES

A. A. Rich and Associates. 1999. Fishery Resources Technical Report. Prepared for Maxim Technologies, Inc. Helena, Montana. January.

AATA International, Inc. 1997. Lahontan Cutthroat Trout, Summary Data Report (Draft). Prepared for Newmont Gold Company. April and May.

_______1998. Lahontan Cutthroat Trout Winter Habitat Survey. Prepared for Newmont Gold Company.

Adrian Brown Consultants, Inc. 1997. Fall 1996 Betze Seep and Spring Study, September-October 1996.

Algermissen, S., D. Perkins, P. Thenhaus, S. Hanson, and B. Bender. 1982. Probabilistic estimates of maximum earthquake acceleration and velocity in rock in the contiguous United States. Open File Report 82-1033. U.S. Geological Survey.

_______1990. Probabilistic earthquake acceleration and velocity maps for the United States and Puerto Rico. U.S. Geological Survey. Map MF-2120.

Baker, E. 1991. Geology and Ore Deposits of the Bootstrap Subdistrict, Elko County, Nevada. In: Geology and Ore Deposits of the Great Basin, Symposium Proceedings. Geological Society of Nevada. Reno, Nevada.

Barbour, R. and W. Davis. 1969. Bats of America. University of Kentucky Press. Lexington.

Barrick Goldstrike Mines, Inc. (Barrick). 1998. Boulder Valley Monitoring Plan. 1998 First Quarter Report. Submitted to Nevada State Engineer, Department of Conservation and Natural Resources.

_______1999. Boulder Valley Monitoring Plan. 1999 First Quarter Report. Submitted to Nevada State Engineer, Department of Conservation and Natural Resources.

_______2000. Boulder Valley Monitoring Plan. 2000 Second and Third Quarter Report. Submitted to Nevada State Engineer, Department of Conservation and Natural Resources.

Bevans, H., M. Lico, and S. Lawrence. 1998. Water quality in the Las Vegas Valley area and the Carson and Truckee River Basins, Nevada and California, 1992-96. U.S. Geological Survey Circular 1170. On line at URL:http://water.usgs.gov/pubs/circ1170/, updated March 19, 1998.

BIO/WEST. 1994. Fisheries Survey of Beaver Creek Drainage, Elko County, Nevada. Summary Report 1994. Prepared for Barrick Goldstrike Mines.

Botts, S. 1988. A Cultural Resources Survey of the Bluestar Operations Area in Eureka County, Nevada. Prepared by Frank Johnson Archaeological Consultant, Crystal Bay, Nevada. Bureau of Land Management Cultural Resources Survey Report 1-1209(p).

Bowles, A. 1995. Responses of Wildlife to Noise *in* Wildlife and Recreationists; Coexistence Through Management and Research. Island Press. Washington D.C.

Bureau of Land Management (BLM), U.S. Department of the Interior. 1985. Elko Resource Area Draft Resource Management Plan and Environmental Impact Statement. Elko Field Office. Elko, Nevada.

_______**1986a.** Visual Resource Inventory. BLM Handbook 8410-1.

_______**1986b.** Visual Resource Contrast Rating. BLM Handbook 8431-1.

_______**1987.** Elko Resource Management Plan, Record of Decision. Elko Field Office. Elko, Nevada.

_______**1991.** Draft Environmental Impact Statement, Betze Project. Barrick Goldstrike Mines, Inc. Elko Field Office. Elko, Nevada.

_______**1992.** Environmental Assessment (EA-NV-010-92-021). Newmont-Tara Exploration Project. Elko and Eureka Counties, Nevada. Elko Field Office. Elko, Nevada.

_______**1993a.** Environmental Assessment Meikle Mine development. Elko Field Office, Elko, Nevada.

_______**1993b.** Environmental Impact Statement, Newmont Gold Company's South Operations Area Project. Includes Draft EIS, Final EIS, and Mitigation Plan. Elko Field Office. Elko, Nevada.

_______**1993c.** Environmental Assessment of Dee Gold Mine Expansion Project. EA-NV-010-91-101. Elko Field Office. Elko, Nevada.

_______**1995a.** Memorandum addressed to the Elko Land and Livestock Grazing Case File. January 23, 1995. Elko Field Office. Elko, Nevada.

_______**1995b.** Environmental Assessment (BLM/EK/PL-95/003), Newmont Gold Company Section 36 Project. Elko Field office. Elko, Nevada.

_______**1996a.** Environmental Assessment (BLM/EK/PL-96/016). Newmont: Lantern Mine Expansion Project. Elko Field Office. Elko, Nevada.

_______**1996b.** Draft Environmental Impact Statement, Newmont Gold Bootstrap Project. Elko Field Office. Elko, Nevada.

_______**1997a.** Field topographic maps showing inventoried springs. Rodeo Creek NE Quadrangle, Nevada. Obtained from Elko Field Office. Elko, Nevada.

_______**1997b.** Riparian monitoring analysis South Operations Area Mitigation Plan. Maggie Creek Watershed Restoration Project. Elko Field Office. Elko, Nevada

_______**1997c.** Nevada Bird List. Elko Field Office. Elko, Nevada.

_______**1997d.** Nevada Reptile and Amphibian List. Elko Field Office. Elko, Nevada.

_______**1998a.** Memorandum addressed to the Elko Land and Livestock Grazing Case File. February 5, 1998. Elko Field Office. Elko, Nevada.

_______**1998b**. Draft Environmental Impact Statement, Trenton Canyon Project. Winnemucca Field Office. Winnemucca, Nevada.

_______**1999.** Out of ashes, opportunity. National Office of Fire and Aviation. Boise, Idaho

_______**2000a.** Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project. Elko Field Office. Elko, Nevada.

_______**2000b.** Draft Supplemental Environmental Impact Statement, Betze Project, Barrick Goldstrike Mines, Inc. Elko Field Office. Elko, Nevada. September 2000.

_______**2000c.** Draft Environmental Impact Statement, Newmont Mining Corporation's South Operations Area Project Amendment. Elko Field Office. Elko, Nevada. September 2000.

Burke, T. 1990. Cultural Resources Technical Report for the Betze Pit Expansion Project Environmental Impact Statement, Eureka and Elko Counties, Nevada. Prepared by Archaeological Research Services. Virginia City, Nevada. Bureau of Land Management Cultural Resources Survey Report 1-1760. Elko District Office. Elko, Nevada.

Burt, W. and R. Grossenheider. 1976. A Field Guide to the Mammals- North America, North of Mexico. Houghton Mifflin Company. Boston, Massachusetts.

Butts, T. 1992. Newmont Gold Quarry. Bat Survey and Inventory, August 23-26, 1992. Prepared for Newmont Gold Company.

Cedar Creek Associates, Inc. 1997. Wildlife Baseline Data Summary Report For Newmont's Carlin Trend Mining Projects. Prepared for Newmont Gold Company. Denver, Colorado.

Chamberlain, R. 1911. The Ethnobotony of the Gosiute Indians. American Anthropological Association Memoir 2(5):329-405.

Chen-Northern, Inc. 1988. Newmont Gold Company, Site Exploration and Geotechnical Investigation of Tailings Disposal Area for No. 4 Mill. Volumes I and II.

Christensen, G. 1970. The Chukar Partridge, Its Introduction, Life History and Management. Nevada Division of Fish and Game. Biological Bulletin No. 4. Reno, Nevada.

City of Elko. 1998. Preliminary Draft – Parks, Recreation, Open Space Plan.

Clark, T. 1987. Mammals in Wyoming. University of Kansas Museum of Natural History. Public Education Series No. 10. University Press of Kansas. Lawrence, Kansas.

Clemmer, R. 1990. The Tosawihi Quarry: World Heritage Site and Western Shoshone Monument. Prepared by Dr. Richard Clemmer, University of Denver. Bureau of Land Management Cultural Resources File 1-1749. Elko Field Office. Elko, Nevada.

Cline, G. 1963. Exploring the Great Basin. University of Oklahoma Press. Norman, Oklahoma.

_______**1974.** Peter Skene Ogden and the Hudson's Bay Company. University of Oklahoma Press. Norman, Oklahoma.

Coates, R. 1987. Geology of Elko County, Nevada. Nevada Bureau of Mines and Geology. University of Nevada. Reno.

Coffin, P. 1981. Distribution and Life History of the Lahontan/Humboldt Cutthroat Trout Within the Humboldt River Drainage Basin. Nevada Department of Wildlife.

Coope, J. 1991. Carlin Trend Exploration History: Discovery of the Carlin Deposit: Nevada Bureau of Mines and Geology. Special Publication No. 13.

Council on Environmental Quality (CEQ). 1997. Environmental Justice, Guidance under the National Environmental Policy Act. Washington, D.C.

County of Elko. 2001. Elko County Combined Statement of Revenues, Expenditures and Changes in Fund Balances – All Government Fund Types, Expendable Trust Funds and Discretely Presented Component Units for the Year Ended June 30, 2000.

County of Eureka. 2001. Elko County Combined Statement of Revenues, Expenditures and Changes in Fund Balances – All Government Fund Types, Expendable Trust Funds for the Year Ended June 30, 2000.

Coxon, D. 1997. Memorandum to Mel Lawson: Waste and Ore Characterization Summary. Newmont Gold Company. Carlin, Nevada. November 5, 1998.

Cronquist, A., A. Holmgren, N. Holmgren and J. Reveal. 1972. Intermountain Flora Vascular Plants of the Intermountain West, U.S.A. Vol. 1. Hafner Publishing Co., New York.

Crum, S. 1994. The Road on Which We Came. University of Utah Press. Salt Lake City.

Deaver, S. 1993. Consultation With the Western Shoshone Regarding the Proposed Expansion of Newmont Gold Quarry Mine, Carlin, Nevada. Technical report prepared by Ethnoscience, Billings, Montana. Manuscript on file at BLM Elko Field Office. Elko, Nevada.

DeGraaf, R., V. Scott, R. Hamre, L. Ernst and S. Anderson. 1991. Forest and Rangeland Birds of the United States: Natural History and habitat Use. U.S. Department of Agriculture, Forest Service. Agriculture Handbook 688.

Desert Research Institute. 1998. Technical Review and Assessment of Ground and Surface Water Relationships in the Tuscarora Mountains. Prepared for Barrick Goldstrike Mines and Newmont Gold Company.

dePolo, D. and C. dePolo. 1999. Earthquakes in Nevada 1852-1998. Nevada Bureau of Mines and Geology Map 119.

Eaton, J. 1994. Literature Assessment of Paleontological Resources along the Emigrant Pass - Battle Mountain Segment (Segment 1) of Nevada Bell Fiber Optic Corridor, Eureka, Lander, and Elko Counties, Nevada. Prepared for Nevada Bell by Sagebrush Archaeological Consultants.

Ehrlich, P., D. Dobkin and D. Wheye. 1988. The Birders Handbook. Simon and Schuster Inc. New York, New York.

Elliot, R. 1966. Nevada's Twentieth Century Mining Boom. University of Nevada Press. Reno.

Elston, R. and E. Budy (editors). 1990. The Archaeology of the James Creek Shelter. Anthropological Papers 115. University of Utah. Salt Lake City.

Elston, R. and M. Drews. 1992. Cultural Chronology. In: Archaeological Investigations at Tosawihi, A Great Basin Quarry: Part 1, The Periphery. Prepared by Intermountain Research. Silver City, Nevada. Bureau of Land Management Cultural Resources Data Recovery Report. On file at the Elko Field Office. Elko, Nevada.

Entwistle, P., A. Debolt, J. Kaltenecker, and K. Steenhof. 2000. Proceedings: Sagebrush Steppe Ecosystem Symposium. Bureau of Land Management Publication No. BLM/10/PT-001001+1150. Boise, Idaho.

Evans, C. 1992. Dee Gold Cumulative Effects Analysis For Mule Deer and Pronghorn Antelope. Bureau of Land Management. Elko Field Office. Elko, Nevada.

Federal Emergency Management Agency (FEMA). 1982. Flood Hazard Boundary Map, Eureka County, Nevada, Unincorporated Area. Panel 1 of 43, Community Panel Number 320028-0001A. Effective date: December 21, 1982.

Firby, J. 1992. Marys River Reverse Land Exchange Paleontological Evaluation and Literature Review. Submitted to Olympic Management, Inc.

______**1993.** Jerritt Canyon Mine Expansion, Independence Mining Company: Evaluation of Paleonotological Resources. Prepared for Welch Engineering Science and Technology, Inc.

Firby, J. and H. Schorn. 1983. Paleontological Inventory of the Elko District, Elko, Nevada. University of Nevada Press. Reno. BLM contract YA553 CTI-108. Elko District Office. Elko, Nevada.

Goodwin, V. 1965. Development of the Emigrant Routes of Northern Nevada. Nevada Historical Society Quarterly 8:27-39.

Gray, K. 1997. Personal communication. Wildlife biologist with Nevada Division of Wildlife. Elko, Nevada.

______**2001.** Personal communication. Wildlife biologist with Nevada Division of Wildlife. Elko, Nevada.

Harris, J. 1940. The White Knife Shoshone of Nevada. In: Acculturation in Seven American Indian Tribes. Edited by R. Linton, pp. 39-116. Appleton, New York.

Haskins, R. 1998. Personal communication March 24, 1998. Regional Fisheries Supervisor. Nevada Division of Wildlife.

Hatono, M. 1980. Caltrans Noise Manual. Federal Highway Administration CA/TL-80/07.

Hawthorne, T. 2001. Personal communication October 25, 2001. Outdoor recreation planner. Elko District Office. Elko, Nevada.

Hazelwood, R. 2000. Personal communication December 11, 2000. Endangered Species Wildlife Biologist. U.S. Fish and Wildlife Service, Endangered Species Office. Helena, Montana.

Herbert, P. 1998. Feasibility Study of Grouting as a Means of Subsurface Water Control. Leeville Project. Eureka County, Nevada.

Herron, G., C. Mortimore and M. Rawlins. 1985. Nevada Raptors, Their Biology and Management. Nevada Division of Wildlife. Biological Bulletin No. 8.

Hill, J. 1918. Notes on Some Mining Districts in Eastern Nevada. U.S. Geological Survey Bulletin 648.

Hoffman, R. and R. Fisher. 1978. Additional distributional records of Preble's shrew (*Sorex preblei)*. Journal of Mammalogy 59:883-884.

Hubbard, T. 1988. Archaeological Survey of Access Roads to the Barrick 120 kV Power Line Right-of-Way. Prepared by Retrospect Research Associates, Ely, Nevada. Bureau of Land Management Cultural Resources Report 1-1148(n).

Hultkrantz, A. 1986. Mythology and Religious Concepts. *In*: Handbook of North American Indians: Great Basin. Edited by W. d'Azevedo, pp. 630-640. Smithsonian Institution. Washington D.C.

Hydrologic Consultants, Inc. (HCI). 1998. Preliminary Estimates of Ground-Water Inflows to Proposed West Leeville Shaft. Prepared for Newmont/Barrick HD Venture. HCI-876/4. March.

_______**1999a.** Numerical Groundwater Flow Modeling of Leeville Project, Eureka County, Nevada. Prepared for Newmont Gold Company. HCI-878. July.

_______**1999b.** Prediction of Potential Hydrologic Impacts of Dewatering Operations Along Northern Carlin Trend. Prepared for Newmont Gold Company. HCI-878. May.

_______**1999c**. Numerical Groundwater Flow Modeling for Newmont Gold Company's South Operations Area Project Amendment, Eureka County, Nevada. Prepared for Newmont Gold Company. HCI-878. September

_______**1999d.** Predicted Maximum Extent of 10-ft Drawdown Isopleth With and Without Leeeville. Job No. HCI-878. June 30, 1999.

_______**2000.** Isopleth Contour Map of Additional Drawdown due to Leeville Dewatering. Job No. HCI-878. March 7, 2000.

_______**2001.** Results of groundwater drawdown and reduction in streamflow at model nodes for Beaver Creek and Jack Creek for cumulative model run.

Inter-Tribal Council of Nevada. 1976. Newe: A Western Shoshone History. Reno, Nevada.

Jackson, M., M. Lane and B. Leach. 1997. Geology of the West Leeville Deposit. Society of Economic Geologists, 16-18.

James, S. 1981. Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Bureau of Land Management Cultural Resource Series 3. Reno, Nevada.

Janetski, J. 1981. Ethnography/Ethnohistory of the Elko and Ely Districts. In: Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Bureau of Land Management Cultural Resource Series 3. Reno, Nevada.

JBR Consultants Group. 1988. Terrestrial Wildlife Little Boulder Basin. Prepared for Barrick Goldstrike Mines, Inc. Elko, Nevada and Newmont Gold Company. Denver, Colorado.

_______**1990a.** Hydrology of Boulder and Bell Creeks. Prepared for Newmont Gold Company, Carlin, Nevada. March 1990.

_______**1990b.** Baseline Inventories for the Boulder and Bell Drainages. Prepared for Newmont Gold Company.

_______**1990c.** Newmont Gold Company Rodeo Creek and Boulder Creek Jurisdictional Wetlands Surveys. Prepared for Newmont Gold Company.

_______**1992a.** Wildlife Resources Little Boulder Basin. Prepared for Newmont Gold Company. Carlin, Nevada.

_______**1992b.** Raptor Nest Locations Newmont Inventory Area Spring and Summer, 1992. Prepared for Newmont Gold Company. Denver, Colorado.

_______**1992c.** Newmont Inventory 1992-1992. Threatened and Endangered Species Studies (Draft Report). Prepared for Newmont Gold Company.

_______**1993.** Wildlife and Aquatic Resources Little Boulder Basin 1992. Prepared for Newmont Gold Company. Carlin, Nevada.

_______**1994.** Wildlife and Aquatic Resources Little Boulder Basin 1993. Prepared for Newmont Gold Company. Carlin, Nevada.

Johnson, F. 1987. A Cultural Resources Survey of the Barrick Mine 120 kV Transmission Line Project in Eureka County, Nevada. Prepared by Frank Johnson Archaeological Consultant. Crystal Bay, Nevada. Bureau of Land Management Cultural Resources Survey Report 1-1126(p). Elko Field Office. Elko, Nevada.

Kuck, L., G. Hompland and E. Merrill. 1985. Elk calf response to simulated mine disturbance in southeast Idaho. Journal of Wildlife Management 49:751-757.

Lamp, R. 2001. Personal communication January 16, 2001. Mine coordinator. Nevada Division of Wildlife. Elko, Nevada.

Leggette, Brashears & Graham, Inc. 1993. Hydrologic Effects of Dewatering at the Goldstrike Mine. Prepared in association with Balleau Groundwater for Barrick Goldstrike Mines Inc. Elko, Nevada.

Lewicki, G. 1997. Leeville Project Erosion Analysis: Newmont/Barrick Joint Venture. Submitted to Newmont Gold Company by Lewicki and Associates. April.

Lincoln, F. 1923. Mining Districts and Mineral Resources of Nevada. Nevada Newsletter Publishing Company. Reno, Nevada.

Maurer, K., R. Plume, J. Thomas and A. Johnson. 1996. Water Resources and Effects of Changes in Groundwater Use along the Carlin Trend, North-Central Nevada. United States Geological Survey. Water Resources Investigations Report 96-4134.

McFarlane, D. 1991a. Gold Production on the Carlin Trend *in* Buffa, R. and A. Coyner, Geology and Ore Deposits of the Great Basin.

_______**1991b.** Geology of the Carlin Trend, in Craig, R., Geology and geochemistry of the Carlin Trend. 15th International Geochemical Exploration Symposium. Association of Exploration Geochemists.

McGuire, D. 1995. A survey of freshwater molusks in Rock, Boulder, and Antelope creeks, Elko and Lander Counties, Nevada. Prepared for Barrick Gold Corporation. Elko, Nevada.

McVehil-Monnett Associates, Inc. 1993. Quarterly Meteorological Monitoring Reports for Newmont Gold Company's North Operations Area.

_______**1994.** Quarterly Meteorological Monitoring Reports for Newmont Gold Company's North Operations Area.

Miller, J. 1983a. Basin Religion and Theology: A Comparative Study of Power (Puha). Journal of California and Great Basin Anthropology 5(1,2):66-86).

______1983b. Numic Religion: An Overview of Power in the Great Basin of Native North American. Anthopos 78:339-354.

Morfield, J. 1996. Current knowledge and conservation status of *Erigonum lewisii* Reveal (Polygonaceae), the Lewis Buckwheat. Nevada Natural Heritage Program. Department of Conservation and Natural Resources. Carson City, Nevada.

______1998. Personal communication January 16, 1998. Nevada Natural Heritage Program.

Moritz, J. 1998. Personal communication March 18, 1998. Bureau of Land Management. Winnemucca Field Office. Winnemucca, Nevada

Murphy, R. and Y. Murphy. 1960. Shoshone-Bannock Subsistence and Society. University of California Anthropological Records 16(7).

Myrick, D. 1962. Railroads of Nevada and Eastern California. Howell-North Books. Berkeley, California.

National Geographic Society. 1987. Field Guide to the Birds of North America. National Geographic Society. Washington D. C.

Nevada Department of Employment, Training and Rehabilitation, Information Development and Processing. 2001a. State of Nevada - County Employment Distributed by Month and Major Industry. Carson City, Nevada.

______2001b. Nevada Labor Force Summary Data (revised). Carson City, Nevada.

______2001c. State of Nevada – Quarterly and Total Payrolls in Covered Employment with Annual Average Wages Distributed by County and Major Industry. Carson City, Nevada.

Nevada Department of Transportation (NDOT). 1995/1996. Official Highway Map.

______1997. Annual Traffic Report. NDOT Research Division, published in cooperation with U.S. Department of Transportation, Federal Highway Administration. Carson City, Nevada.

Nevada Division of Environmental Protection (NDEP). 1997. Bureau of Air Quality Internet Website.

______1998. Nevada's 1998 Section 303(d) List. Bureau of Water Quality Planning. April.

______2000. Mercury Emissions from Major Mining Operations in Nevada. November.

Nevada Division of State Parks (NDSP). Undated brochure.

______1992. Statewide Comprehensive Outdoor recreation Plan.

______1998. Nevada State Parks Visitation Summary Calendar Year 1997.

Nevada Division of Wildlife (NDOW). 1992. Wildlife and Wildlife Habitats Associated with the Humboldt River and Its Tributaries.

______2000. Fish sampling in Coyote Creek and Beaver Creek, Region II. Elko, Nevada.

Nevada State Conservation Commission. 1994. Handbook of Best Management Practices.

Newmont Mining Corporation (Newmont). 1995a. Spill Prevention, Control, and Countermeasure (SPCC) Plan.

_______**1995b.** Emergency Response Plan.

_______**1995c.** Stormwater Pollution Prevention Plan.

_______**1996.** HDDW-1a Aquifer Test by Paul Pettit, Hydrology Department, Newmont/Barrick HD Venture. Carlin, Nevada. May.

_______**1997a.** Proposed Plan of Operations for the Leeville Project. Newmont/Barrick High Desert (HD) Venture. Submitted to Bureau of Land Management. Elko District Office. Elko, Nevada. April.

_______**1997b**. 1996 Aquifer Testing Report. Newmont/Barrick HD Venture, Hydrology Department. Carlin, Nevada. April.

_______**1998.** Regional Water Monitoring System Map; Nevada Humboldt River Basin (4); Carlin Trend; NGC and BGM Spring Surveys & Monitoring Plans. Hydrology Department. March.

_______**1999a.** Interpretive Geology of the Northern Carlin Trend.

_______**1999b**. Maggie Creek Basin Monitoring Plan. Second Quarter 1999 Report. September.

_______**2000.** Maggie Creek Basin Monitoring Plan, First Quarter 2000 Report. Carlin, Nevada.

_______**2001.** Maggie Creek Basin Monitoring Plan, Fourth Quarter 2000 Report. Carlin, Nevada.

Newsome, D. 1992a. Cultural Resources Inventory of the High Desert Parcel, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1567(p). Elko Field Office. Elko, Nevada.

_______**1992b.** Cultural Resources Inventory of the Chevas Parcel, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1628(p). Elko Field Office. Elko, Nevada.

_______**1996** Cultural Resources Inventory of the Carlin Plan of Operations Area, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-2026(p). Elko Field Office. Elko, Nevada.

_______**1997.** Cultural Resources Inventory of Alternative Routes for the Proposed Leeville Dewatering Pipeline, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1652(p). Elko Field Office. Elko, Nevada.

Newsome, D. and B. Tipps. 1997. Cultural Resources Inventory of the GQX Parcels and Summary of the South Operations Area Project, Elko and Eureka Counties, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1651(p). Elko Field Office. Elko, Nevada.

Nyrehn, D. 1998. Personal communication January 22, 1998. Rangeland Management Specialist, Bureau of Land Management. Elko Field Office. Elko, Nevada.

______ **2002.** Personal communication, January 29, 2002. Rangeland Management Specialist, Bureau of Land Management, Elko Field Office, Elko, Nevada.

Patterson, E., L. Ulph and V. Goodwin 1969. Nevada's Northeast Frontier. Western Printing and Publishing Company. Sparks, Nevada.

Peterson, H. 1978. Sheep Creek Drift Fence #5042. Bureau of Land Management Cultural Resources Report Field Worksheet 1-151(n). On file at the Elko Field Office. Elko, Nevada.

Pettit, P. 2001. Personal communication. Hydrology Manager, Newmont Mining Corporation. Carlin, Nevada.

Plume, R. 1994. Water resources and potential effects of ground-water development in Maggie, Marys, and Susie creek basins, Elko and Eureka counties, Nevada. USGS Water-Resources Investigations Report 94-4222.

Popek, G. 1990. Class III Cultural Resources Inventory of a Portion of Section 34, T. 36 N., R. 49 E., Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1345(p). Elko Field Office. Elko, Nevada.

Ports, M. and S. George. 1990. *Sorex preblei* in the Northern Great Basin. Great Basin Naturalist 50(1):93-95.

Power Engineers, Inc. 1997. Plan Set. October.

______ **1998.** Newmont Gold Company Joint Venture Leeville Pipeline, Integrated Report for Phases 1 and 2. June.

Radtke, A. 1985. Geology of the Carlin Gold Deposit, Nevada. U.S. Geological Survey Professional Paper 1267.

Rawlings, M and L. Neel. 1989. Wildlife and Wildlife Habitats Associated with the Humboldt River and Its Tributaries. Biological Bulletin No. 10. Nevada Division of Wildlife. Reno, Nevada.

Reagan, J. and A. Grant. 1977. Highway Construction Noise Prediction and Mitigation. Federal Highway Administration Special Report. U.S. Department of Transportation. Washington, D.C.

Regnier, J. 1960. Cenozoic Geology of the Vicinity of Carlin, Nevada. Geologic Society of America Bulletin. Volume 71.

Resource Concepts, Inc. (RCI). 1998. Order II soil survey for the Leeville Mine Project Area. Prepared for Maxim Technologies, Inc. (in press).

Riverside Technology, Inc. (RTI). 1994. Seep, Spring, and Stream Inventory. Barrick Goldstrike Mine Dewatering Study Area, Volume I and II. Prepared for Barrick Goldstrike Mines, Inc., Elko, Nevada. April.

Rubens, R., K. Montgomery and R. Lehner. 1967. Geology and Mineral Resources of Eureka County, Nevada. Nevada Bureau of Mines Bulletin 64.

Rusco, M. and S. Raven. 1992. Background Study for Consultation with Native Americans on Proposed Mining Development within the Traditional *Tosawihi* ('White Knife') Quarry North of Battle Mountain, Nevada in the Traditional Land of the *Tosawihi* People, Western Shoshone Nation.

Ryall, A. 1977. Earthquake Hazard in the Nevada Region. Bulletin of the Seismological Society of America. Volume 67, No. 2, pp. 517-532. April.

Ryser, F. 1985. Birds of the Great Basin, a Natural History. University of Nevada Press. Reno.

Sawyer, B. 1971. Nevada Nomads: A Story of the Sheep Industry. Harlan-Young Press. San Jose, California.

Schroedl, A. 1986. Cultural Resources Inventory in Little Boulder Basin, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1040(p). Elko Field Office. Elko, Nevada.

______**1990.** Class III Cultural Resource Inventory of the Santa Fe Pacific Parcel, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1323(p). Elko Field Office. Elko, Nevada.

______**1995.** Open Site Archaeology in Little Boulder Basin: 1992 Data Recovery Excavations in the North Block Heap Leach Facility Area, North-Central Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-2021(p). Elko Field Office. Elko, Nevada.

Sierra Pacific Power Company (SPPC). 1994. A Business Portrait of Northeast Nevada; Carlin, Elko, Wells, and West Wendover. Economic Development Department. Reno, Nevada.

Slemmons, D. 1983. Evaluation of Potential for Surface Faulting and the Design Earthquake Parameters for the Gold Quarry Project of Newmont Services Limited, Eureka County, Nevada. Prepared for Sergent, Hauskins & Beckwith.

Soil and Water Conservation Society (SWCS). 1993. Revised Universal Soil Loss Equation (RUSLE). Version 1.03. Akney, Iowa.

Steward, J. 1937. Ethnological Reconnaissance Among the Desert Shoshoni. Explorations and Field Work of the Smithsonian Institution in 1934. Smithsonian Institution. Washington.

______**1938.** Basin-Plateau Aboriginal Sociopolitical Groups. Bureau of American Ethnology Bulletin 120.

______**1941.** Cultural Element Distributions: XIII, Nevada Shoshoni. University of California Anthropological Papers 4(2):209-359.

______**1943.** Cultural Element Distributions: XXIII, Northern and Gosiute Shoshoni. University of California Anthropological Papers 8(3):263-392.

Stewart, J. and E. McKee. 1977. Geology and Mineral Deposits of Lander County, Nevada. Bulletin 88 Part 1, Geology. Nevada Bureau of Mines and Geology.

Stratford, M. 1994. Cultural Resources Inventory of the Bluestar Mine Area, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1944(n). Elko Field Office. Elko, Nevada.

______**1996.** Cultural Resources Inventory and Testing in Section 3, T. 35 N., R. 50 E., Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1636(p). Elko Field Office. Elko, Nevada.

Thomas, D., L. Pendleton and S. Cappannari. 1986. Western Shoshone. In: Great Basin. Edited by W. d'Azevedo. Handbook of North American Indians II. Smithsonian Institute. Washington D.C.

Tipps, B. 1988. Archaic and Numic Encampment in the Little Boulder Basin, Eureka County, Nevada. Cultural Resources Report 1-1188. Prepared by P-III Associates, Inc. Salt Lake City, Utah. Elko Field Office. Elko, Nevada.

Tipps, B. and G. Popek. 1990. Class III Cultural Resource Inventory in the Ranch Reservoir Area, Eureka County, Nevada. Prepared by P-III Associates. Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1287(p). Elko Field Office. Elko, Nevada.

Tipps, B., G. Popek and D. Kice. 1993. Class III Cultural Resources Inventory of Portions of Sections 17, 18, 19, 29, and 30, T. 36 N., R. 50 E., Eureka County, Nevada. Prepared by P-III Associates, Salt Lake City, Utah. Bureau of Land Management Cultural Resources Survey Report 1-1684(p). Elko Field Office. Elko, Nevada.

U.S. Bureau of Mines and Geology. 1976. Noise and Vibrations in Residential Structures from Quarry Production Blasting. Report of Investigations 8168.

U.S. Dept. of Agriculture. Natural Resource Conservation Service (NRCS). 1980. (Formerly Soil Conservation Service). Soil Survey of Tuscarora Mountain Area, Parts of Elko, Eureka and Lander Counties, Nevada.

_______**1992.** Range Site Descriptions for the Owyhee High Plateau Area, MLRA 25. Revised May 20, 1993.

_______**1993.** National Soil Survey Interpretation Handbook. U.S. Government Printing Office. Washington, D.C.

U.S. Department of Commerce. Bureau of the Census. 1990. U.S. Census Summary Tape Files.

_______**2000.** U.S. Census, 2000 Redistricting Data.

_______**2001.** DP-1: Profile of General Demographic Characteristics (2000). Census 2000 Summary File 1 (SF 1) 100-Percent Data.

U.S. Department of Commerce. Economics and Statistics Administration, Regional Economic Information System. Bureau of Economic Analysis. 2001. Average Per Capita Personal Income.

U.S. Department of the Interior. Bureau of Indian Affairs. 2001. Local Estimates of Resident Indian Population and Labor Market Information – Male and Female Indians Living on-or-Near Reservation – Summary by Tribe or Reservation. Te-Moak Tribes. Elko County, Nevada.

U.S. Department of Interior. Fish and Wldlife Service (USFWS). 1995. Recovery Plan for Lahontan Cutthroat Trout (*Oncorhynchus clarki henshawi)* (Salmonidae). Portland, Oregon.

U.S. Environmental Protection Agency (EPA). 1978. Protective Noise Levels. Office of Noise Abatement and Control. EPA 550/9-79-100. Washington, D.C.

_______**1998.** Final Guidance for Incorporating Environmental Justice Concerns in EPA's NEPA Compliance Analysis. Washington, D.C.

_______**1999.** Office of Air Quality Planning and Standards. AIRSData.

U.S. Geological Survey (USGS). 1968. Rodeo Creek NE Quadrangle Map, Nevada, Eureka Co.; 7.5 Minute Series (topographic).

_______**1988.** Geologic Survey Quad 1:100,000 Battle Mountain, Nevada.

_______**2000.** Water Resources Data, Nevada, Water Year 1999. USGS Water-Data Report NV-99-1. Carson City, Nevada.

_______**2001.** Provisional Water Resources Data, Nevada, Water Year 2000. Obtained from USGS office in Carson City, Nevada. April 2001.

Valdez, R. and M. Trammel. 2000. Final report: Stream surveys of Maggie Creek subbasin, Nevada. Prepared for Newmont Mining Corporation. Carlin, Nevada.

Vestrom, C. and H. Mason. 1944. Agricultural History of Nevada. University of Nevada. Reno.

Vlasich, J. 1981. History of the Elko and Ely Districts. In: Prehistory, Ethnohistory, and History of Eastern Nevada: A Cultural Resources Summary of the Elko and Ely Districts. Nevada Bureau of Land Management Cultural Resource Series 3. Reno, Nevada.

Welsh Engineering, Inc., 1989. Environmental Assessment for the Newmont Gold Company's Blue Star Operations Area, Eureka County, Nevada. Submitted by Newmont Gold Company, Carlin, Nevada. May.

Western Regional Climate Center. 2001. National Climate Data Center (NCDC) Monthly Normals for Beowave (1949-2000), Newmont's Carlin Mine (1966-2000), Elko (1888-2000), and Tuscarora (1957-2000), Nevada Stations. http://www.wrcc.dri.edu/cgi-bin/.

Whitaker, J. 1988. The Audubon Society Field Guide to North American Mammals. Alfred A. Knopf, Inc. New York, New York.

Wilderness Society. 1989. Map of U.S. Wilderness Areas.

Young, B. 1989. Archaeological Inventory of Santa Fe Pacific Mining Company's Proposed Boulder Valley Exploration Access Road. Prepared by Archaeological Research Services. Virginia City, Nevada. Bureau of Land Management Cultural Resources Survey Report 1-1248(p). Elko Field Office. Elko, Nevada.

Young, J. and A. Sparks. 1985. Cattle in the Cold Desert. Utah State University Press. Logan, Utah.

Zevaloff, S. 1988. Mammals of the Intermountain West. University of Utah Press. Salt Lake City, Utah.

This page intentionally left blank.

LIST OF ACRONYMS

AGP	acid-generating potential
AFDC	Aid to families with dependent children
AIRFA	American Indian Religions Freedom Act
AMSL	above mean sea level
ANFO	ammonium nitrate and fuel oil
ANP	acid-neutralizing potential
APE	area of potential effect
AWHC	available water holding capacity
AUM	animal unit month
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
B.P.	before present
CEQ	Council on Environmental Quality
CFB	circulating fluidized bed
CFR	Code of Federal Regulations
CIL	carbon-in-leach
CIP	carbon-in-pulp
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EMT	emergency medical technician
ESD	ecological site description
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FLPMA	Federal Land Policy and Management Act
FY	fiscal year
HCN	hydrogen cyanide
HDPE	high-density polyethylene
IF	isolated finds
ISO	Insurance Services Office
KOP	key observation point
LCT	Lahontan cutthroat trout
MCE	maximum credible earthquake

MSHA	Mine Safety and Health Administration
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NAGPRA	Native American Graves Protection and Repatriation Act
NANP	net acid neutralization potential
NDCNR	Nevada Department of Conservation and Natural Resources
NDEP	Nevada Division of Environmental Protection
NDH	Nevada Division of Health
NDOT	Nevada Department of Transportation
NDOW	Nevada Division of Wildlife
NDSP	Nevada Division of State Parks
NDWR	Nevada Division of Water Resources
NENDA	Northeast Nevada Development Authority
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	national pollution discharge elimination system
NRHP	National Register of Historic Places
NRS	Nevada Revised Statutes
ORV	off-road vehicle
OSHA	Occupational Safety and Health Administration
PLS	pure live seed
POO	plan of operations
PMP	probable maximum precipitation
PSC	Public Service Commission
PSD	prevention of significant deterioration
RA	resource area
RCRA	Resource Conservation and Recovery Act
RMP	Resource Management Plan
ROD	Record of Decision
RRD	root restricting depth
RUSLE	Revised Universal Soil Loss Equation
SARA	Superfund Amendments and Reauthorization Act
SCORP	Statewide Comprehensive Outdoor Recreation Plan

SCS	Soil Conservation Service
SHPO	State Historic Preservation Officer
SPPC	Sierra Pacific Power Company
SRA	State Recreation Area
SRMA	special recreational management area
TCLP	toxicity characteristic leaching procedure
TCP	traditional cultural properties
TDF	tailings disposal facility
TDS	total dissolved solids
TPQ	threshold planning quantity
TSP	total suspended particulate
TSS	total suspended solids
USCOE	United States Army Corps of Engineers
USC	United States Code
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VRM	visual resource management
WAD	weak acid dissociable
WEG	wind erodibility group
WIC	women with infants and children
WSA	wilderness study area

This page left intentionally blank

UNITS OF MEASURE

Bcy	bank cubic yards
C	Celsius
cfs	cubic feet per second
cy	cubic yards (same as loose cubic yards)
dB	decibel
dBA	A-weighted decibel sound scale
F	Fahrenheit
ft	feet
g	gravity
gal	gallon
gpm	gallons per minute
in	inch
kV	kilovolt
lb	pound
lcy	loose cubic yards
$\mu g/m^3$	micrograms per cubic meter
μmhos/cm	micromhos per centimeter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mgpd	million gallons per day
MM	million
mph	miles per hour
ppm	parts per million
%	percent
tpy	tons per year

This page left intentionally blank

GLOSSARY

Acre-feet. The volume required to cover 1 acre to a depth of 1 foot, which is equivalent to 43,560 cubic feet.

Acid Rock Drainage (ARD). Water with pH less than 5, elevated TDS, SO_4, and trace metal concentrations that result from the oxidation of acid generating sulfide minerals with subsequent dissolution and transport of the oxidation products.

Acid Generation Potential (AGP). The concentration of acid generating minerals in a rock or soil material, measured in tons of $CaCO_3$ equivalents per kiloton of rock.

Acid Neutralization Potential (ANP). The concentration of acid neutralizing minerals in a rock or soil material, measured in tons of $CaCO_3$ equivalents per kiloton of rock.

Alluvial. Pertaining to material or processes associated with transportation or deposition of soil and rock by flowing water (e.g., streams and rivers).

Alluvium. Soil and rock deposited by flowing water (e.g., streams and rivers); consists of unconsolidated deposits of sediment, such as silt, sand, and gravel.

Alteration. A geochemical process involving mineralogic and geochemical changes due to reaction with fluids moving through rock or soil under natural conditions, particularly in association with mineral deposits. Transformation of feldspar minerals to clay through chemical weathering is considered alteration.

Ambient. Surrounding, existing, background conditions.

Anticline. A fold in rock, where the interior of the fold is comprised of rocks that are older in age than the rocks on the exterior of the fold.

Assay. Qualitative or quantitative analysis of a substance (e.g., ore body).

Basic Elements (visual). The four major elements (form, line, color, and texture) which determine how the character of a landscape is perceived.

Capillary Break. A layer of specified material (usually cobble-sized) used to prevent capillary movements of fluids from one material to another.

Cation Exchange Capacity. The number of sites on a solid surface where reversible cation adsorption and desorption can occur.

Contrast (visual). The effect of a striking difference in form, line, color, or texture of the landscape features within the area being viewed.

Critical (Crucial) Habitat. Habitat that is present in minimum amounts and is a determining factor for population maintenance and growth.

dBA. The sound pressure levels in decibels measured with a frequency weighing network corresponding to the A-scale on a standard sound level meter. The A-scale tends to suppress lower frequencies (e.g., below 1,000 Hz).

Decant. To remove or pour off a liquid without disturbing associated sediment or solids.

Decibel (dB). One-tenth of a Bel is a measure on a logarithmic scale which indicates the ratio between two sound powers. A ratio of 2 in power corresponds to a difference of 3 decibels between two sounds. The decibel is the basic unit of sound measure.

Dissolution. The process of dissolving

Electrical Conductivity (or Specific Conductance). The ability of a water or a soil-water paste to transmit electrical current, used to estimate ion concentration.

Endangered Species. Species in danger of extinction throughout all or a significant portion of its range.

Eolian. Soil and silt deposited by wind, such as loess.

Ephemeral Stream. A stream or portion of a stream which flows briefly in direct response to precipitation in the immediate vicinity, and whose channel is at all times above the water table.

EPA Synthetic Precipitation Leachability Procedure (SPLP) – Method 1312. A weak acid bottle roll extraction conducted to simulate metal release from mined material due to exposure to ambient conditions.

Evapotranspiration (ET). The portion of precipitation returned to the air through evaporation and transpiration.

Floodplain. The low and relatively flat areas adjacent to rivers and streams. A 100-year floodplain is that area subject to a 1 percent or greater chance of flooding in any given year.

Flux. Volume of groundwater per unit time that travels through a solid permeable medium, such as alluvium and bedrock.

Forage. Vegetation used for food by wildlife, particularly big game wildlife and domestic livestock.

Forbs. Any herbaceous plant other than a grass.

Fry. The young of fish.

Game Species. Animals commonly hunted for food or sport.

Hertz (Hz). The unit of frequency (i.e., sound) formerly designated as cps - cycles per second.

Host Rock. A rock body or wall rock enclosing mineralization.

Hydraulic Conductivity (K). A coefficient of proportionality describing the rate at which water can move through a permeable medium.

Hydraulic Gradient. For groundwater, the rate of change of total head per unit of distance of flow at a given point and in a given direction.

Hydrograph. A graph that shows some property of groundwater or surface water as a function of time.

Hydrophytic Vegetation. The total of macrophytic plant life that occurs in areas where the frequency and duration of inundation or soil saturation produce permanently or periodically saturated soils of sufficient duration to exert a controlling influence on the plant species present.

Hydrostratigraphic Unit. A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for grouping into aquifers or confining layers.

Intermittent Stream. Stream that flows only part of the time or during part of the year; some segments of the stream may flow year-round.

Irretrievable. Typically used to describe renewable resources that are lost for a period of time such as timber production from land that has been converted to use for a ski area or other activity.

Irreversible. Usually used to describe use of nonrenewable resources such as extraction of minerals or removal of cultural resources where the resource is, for all intents and purposes, lost. This term is also applicable to loss of future options or alternatives based on present decisions.

Isopleth. A line, on a map or chart, drawn through points of equal size or abundance.

Key Observation Point (KOP). An observer position on a travel route used to determine visible area.

Lithic Scatter. A discrete grouping of flakes of stone created as a byproduct in the tool-making process. Often includes flakes used as tools as well as formal stone tools such as projectile points, knives, or scrapers.

Maximum Credible Earthquake. The largest conceivable earthquake that could occur in an area.

Mesic. Moist habitats associated with springs, seeps, and riparian areas.

Mitigation. Actions to avoid, minimize, reduce, eliminate, replace, or rectify the impact of a management practice.

Overburden. Sub-economic non-ore rock or soil associated with a mineral deposit.

Oxidation. A geochemical process involving chemical and mineralogic changes to rock or soil under chemical weathering conditions. Oxidation is typically associated with exposure of buried materials to atmospheric oxygen and water. The process occurs naturally, but is accelerated by mining activity.

Peak Flow. The greatest flow attained during melting of winter snowpack or during a large precipitation event.

Perennial Stream. A stream that flows throughout the year and from source to mouth.

Permeability. The capacity of porous rock, sediment, or soil to transmit a fluid.

pH. The negative $\log_{10}$ of the hydrogen ion activity in solution; measure of acidity or alkalinity of a solution.

$PM_{2.5}$/PM_{10}. Particulate matter less than 2.5/10 microns in aerodynamic diameter.

Probable Maximum Precipitation (PMP). The greatest depth of precipitation for a given duration that is physically possible over a given storm area at a particular location at a certain time of year.

Raptor. A bird of prey (e.g., eagles, hawks, falcons, and owls).

Richter Magnitude. Logarithmic scale of earthquake intensity.

Riparian. Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites.

Run-of-Mine Overburden. Sub-economic rock mined from the phosphate deposit, which is and placed in surface dumps or as pit backfill

Salinity. Measure of solute concentration, in grams per kilogram; “saltiness”.

Scoping. Procedures by which agencies determine the extent of analysis necessary for a proposed action, (i.e., the range of actions, alternatives, and impacts to be addressed; identification of significant issues related to a proposed action; and the depth of environmental analysis, data, and task assignments needed).

Sediment Load. The amount of sediment (sand, silt, and fine particles) carried by a stream or river.

Seepage Collection System. A system of drains, ponds, and pumps to collect and return tailing impoundment and embankment seepage.

Significant. As used in NEPA, requires consideration of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole, and the affected region, interests, and locality. Intensity refers to the severity of impacts (40 CFR 1508.27)

Sodium Adsorption Ratio (SAR). Ratio of dissolved sodium to calcium+magnesium in water; provides a prediction of cation exchange reaction potential.

Sulfides. That part of a lode or vein not yet oxidized by air or surface water and containing sulfide minerals.

Sulfide Oxidation. Chemical conversion of reduced sulfide compound to an oxidized sulfate compound, with associated release of iron and formation of secondary iron oxide mineralization.

Storage Coefficient (S). Volume of water that an aquifer releases from storage per unit surface area of aquifer per unit decline in the component of hydraulic head normal to the surface: S is dimensionless.

Syncline. A folded rock sequence where the interior of the fold is younger than the rock on the exterior.

Threatened Species. Any species of plant or animal which is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Total Suspended Particulate (TSP). Particulates less than 100 microns in diameter (Stokes equivalent diameter).

Total Dissolved Solids (TDS). Total amount of dissolved material, organic or inorganic, contained in a sample of water.

Total Suspended Solids (TSS). Undissolved particles suspended in liquid.

Transmissivity (T). The rate at which water will flow through a vertical strip of aquifer one foot wide and extending through the full saturated thickness, under a hydraulic gradient of 1.0.

Ungulate. A hoofed mammal.

Visual Quality Objective (VQO). A desired level of excellence based on physical and sociological characteristics of an area. Refers to degree of acceptable alteration of the characteristic landscape.

Watershed. Drainage basin for which surface water flows to a single point.

Wetlands. Areas inundated by surface water or groundwater with a frequency sufficient to support vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

Wetland Functions. Dynamic biological, chemical, and physical processes that characterize wetland ecosystems.

Wetland/Riparian Zone Vegetation Types.

Streambar. Above streamside type on stream deposits below ordinary high water mark (OHWM).

Herbaceous Streambar. In or immediately adjacent to streams at or below OHWM or within channel or adjacent to stream below OHWM; in low lying oxbows, meanders, and sloughs with standing water or high groundwater throughout or late into the growing season; older relatively, dry meanders and upland terraces.

Wet Meadow. Within perennial streams or artesian seeps and springs in broad floodplains; ponds formed in deeper oxbows, meanders, borrow pits, or other depressions.

Salix Streambar. Seasonally flooded levees and channels; recently exposed stream-laid deposits, moist to wet soils lining channel banks, newer oxbows and meanders; older stream-laid deposits and older oxbows and meanders and irrigation ditches.

Salix/Wet Meadow. Seasonally flooded, saturated, or semi-permanently flooded wetland.

Salix/Mesic Meadow. Banks adjacent to streams or in areas of high water table; moist, subirrigated low areas.

Salexi/Mesic Meadow. Intermittently or seasonally flooded channels and levees.

Mesic Meadow. Seasonally flooded wetland.

Wetland Values. Based on societal properties by which wetlands are determined to be useful, or impart public good.

APPENDIX A

Summary of BLM Consultation Efforts and Information Exchange Related to the Leeville Project

Summary of BLM'S Consultation Efforts and Information Exchange Related to the Leeville Project

Contact Date	Contacted	Via	Response
5-22-97	Te-Moak Tribal Chair	Certified Letter	No response
	Elko Bank Chair	Certified Letter	No response
	Battle Mountain Band Chair	Certified Letter	No response
	Wells Band Chair	Certified Letter	No response
	South Fork Band Chair	Certified Letter	Response 5-30-97
	WSHPS[1]	Certified Letter	No response
6-19-97	Te-Moak Tribal Chair	Phone Call	No response
	Elko Band Chair	Phone Call	No response
	Battle Mountain Band Chair	Phone Call	No response
	Wells Band Chair	Phone Call	No response
	WSHPS	Phone Call	Response 6-27-97
8-25-97	Te-Moak Tribal Chair	Certified Letter	No response
	Elko Band Chair	Certified Letter	No response
	Battle Mountain Band Chair	Certified Letter	No response
	Wells Band Chair	Certified Letter	No response
9-28-98	Te-Moak ED[2]	Monthly Meetings[3]	0 Rep.[4] Present
	Duck Valley ED	Monthly Meetings	2 Rep. Present
	Elko Band ED	Monthly Meetings	0 Rep. Present
	Battle Mountain Band ED	Monthly Meetings	1 Rep. Present
	Wells Band ED	Monthly Meetings	1 Rep. Present
	South Fork Band ED	Monthly Meetings	0 Rep. Present
	WSHPS	Monthly Meetings	1 Rep. Present
	WSDP[5]	Monthly Meetings	3 Rep. Present
10-1-98	Te-Moak Tribal Chair	Certified Letter	No response
	Duck Valley Tribal Chair	Certified Letter	No response
	Shoshone-Bannock ED	Certified Letter	No response
	Elko Band Chair	Certified Letter	Response 10-16-98
	Battle Mountain Band Chair	Certified Letter	No response
	Wells Band Chair	Certified Letter	No response
	South Fork Band Chair	Certified Letter	No response
	WSHPS	Certified Letter	Response 10-16-98
	WSDP	Certified Letter	No response
10-26-98	Te-Moak Tribal Chair	Monthly Meetings	0 Rep. Present
	Duck Valley ED	Monthly Meetings	1 Rep. Present
	Shoshone-Bannock Chair	Monthly Meetings	0 Rep. Present
	Yomba Tribal Chair	Monthly Meetings	0 Rep. Present
	Elko Band Chair	Monthly Meetings	0 Rep. Present
	Battle Mountain Band Chair	Monthly Meetings	1 Rep. Present
	Wells Band Chair	Monthly Meetings	0 Rep. Present
	South Fork Band Chair	Monthly Meetings	0 Rep. Present
	WSHPS	Monthly Meetings	1 Rep. Present
	WSDP	Monthly Meetings	2 Rep. Present
12-16-98	Te-Moak Tribal Chair	Certified Letter	No response
	Duck Valley Tribal Chair	Certified Letter	No response
	Shoshone-Bannock ED	Certified Letter	No response
	Elko Band Chair	Certified Letter	No response
	Battle Mountain Band Chair	Certified Letter	No response
	Wells Band Chair	Certified Letter	No response
	South Fork Band Chair	Certified Letter	No response
	WSDP	Certified Letter	Response 12-1-98
1-5-99	Te-Moak Tribal Chair	Meeting at BLM	0 Rep. Present
	Duck Valley Tribal Chair	Meeting at BLM	1 Rep. Present
	Shoshone-Bannock ED	Meeting at BLM	0 Rep. Present
	Elko Band Chair	Meeting at BLM	0 Rep. Present
	Battle Mountain Band Chair	Meeting at BLM	1 Rep. Present
	Wells Band Chair	Meeting at BLM	2 Rep. Present
	South Fork Band Chair	Meeting at BLM	2 Rep. Present
	WSHPS	Meeting at BLM	1 Rep. Present
	WSDP	Meeting at BLM	4 Rep. Present

Summary of BLM'S Consultation Efforts and Information Exchange Related to the Leeville Project			
Contact Date	**Contacted**	**Via**	**Response**
2-2-99	Te-Moak Tribal Chair	Meeting at GBC[6]	0 Rep. Present
	Duck Valley ED	Meeting at GBC	2 Rep. Present
	Shoshone-Bannock ED	Meeting at GBC	0 Rep. Present
	Elko Band Chair	Meeting at GBC	1 Rep. Present
	Battle Mountain Band ED	Meeting at GBC	1 Rep. Present
	Wells Band Chair	Meeting at GBC	0 Rep. Present
	South Fork Band Chair	Meeting at GBC	0 Rep. Present
	WSHPS	Meeting at GBC	1 Rep. Present
	WSDP	Meeting at GBC	3 Rep. Present
2-9-99	Te-Moak Tribal Chair	Certified Letter	No response
	Duck Valley Tribal Chair	Certified Letter	No response
	Shoshone-Bannock ED	Certified Letter	No response
	Elko Band Chair	Certified Letter	No response
	Battle Mountain Band Chair	Certified Letter	No response
	Wells Band Chair	Certified Letter	No response
	South Fork Band Chair	Certified Letter	No response
	WSHPS	Certified Letter	No response
	WSDP	Certified Letter	No response
3-15-99	Te-Moak Tribal Chair	Meeting at BLM	Response 3-15-99
	Duck Valley Tribal Chair	Meeting at BLM	1 Rep. Present
	Shoshone-Bannock ED	Meeting at BLM	0 Rep. Present
	Elko Band Chair	Meeting at BLM	2 Rep. Present & Response 3-23-99
	Battle Mountain Band Chair	Meeting at BLM	0 Rep. Present
	Wells Band Chair	Meeting at BLM	0 Rep. Present
	South Fork Band Chair	Meeting at BLM	2 Rep. Present
	WSHPS	Meeting at BLM	0 Rep. Present
	WSDP	Meeting at BLM	3 Rep. Present & Response 5-21-99
	Yomba Tribe	Meeting at BLM	1 Rep. Present
7-22-99	South Fork Band ED	In the Field	2 Rep. Present
	Wells Band ED	In the Field	1 Rep. Present
	Elko Band ED	In the Field	1 Rep. Present
	Battle Mountain Band ED	In the Field	4 Rep. Present
9-2-99	Te-Moak Tribal Chair	Fax	No response
	Duck Valley Tribal Chair	Fax	No response
	Elko Band ED	Fax	No response
	Battle Mountain Band ED	Fax	No response
	Wells Band Chair	Fax	No response
	South Fork Band Chair & ED	Fax	No response
	WSHPS	Fax	No response
	WSDP	Fax	No response
3-15-00	Te-Moak Tribal Chair	Monthly Meetings	1 Rep. Present
	Duck Valley ED	Monthly Meetings	0 Rep. Present
	Shoshone-Bannock Chair	Monthly Meetings	0 Rep. Present
	Elko Band Chair	Monthly Meetings	0 Rep. Present
	Battle Mountain Band Chair	Monthly Meetings	2 Rep. Present
	Wells Band Chair	Monthly Meetings	1 Rep. Present
	South Fork Band Chair	Monthly Meetings	2 Rep. Present
	Ely Shoshone Tribe	Monthly Meetings	2 Rep. Present
	WSDP	Monthly Meetings	2 Rep. Present
9-26-00	Te-Moak Tribal Chair	Certified Letter	Response 10-30-00
	Duck Valley Tribal Chair	Certified Letter	No response
	Elko Band Chair	Certified Letter	No response
	Battle Mountain Band Chair	Certified Letter	Response 11-14-00
	Wells Band Chair	Certified Letter	Response 10-19-00
	South Fork Band Chair	Certified Letter	No response
	WSDP	Letter	Response 10-31-00
	Ely Shoshone Tribe	Letter	Response 10-31-00
	Lois Whitney, WSA[7]		Response 10-31-00

Summary of BLM'S Consultation Efforts and Information Exchange Related to the Leeville Project			
Contact Date	**Contacted**	**Via**	**Response**
9-27-00	Te-Moak Tribal Chair	Monthly Meetings	1 Rep. Present
	Elko Band Chair	Monthly Meetings	1 Rep. Present
	Battle Mountain Band Chair	Monthly Meetings	1 Rep. Present
	Wells Band Chair	Monthly Meetings	1 Rep. Present
	South Fork Band Chair	Monthly Meetings	2 Rep. Present
	WSDP	Monthly Meetings	1 Rep. Present
	Duckwater Tribe	Monthly Meetings	2 Rep. Present
11-28-00 / 12-7-00	Te-Moak Tribal Chair & ED	CL[8]/Meeting at BLM	0 Rep. Present
	Duck Valley Tribal Chair	CL/Meeting at BLM	0 Rep. Present
	Elko Band Chair	CL/Meeting at BLM	0 Rep. Present
	Battle Mountain Band Chair & ED	CL/Meeting at BLM	1 Rep. Present
	Wells Band Chair & ED	CL/Meeting at BLM	2 Rep. Present
	South Fork Band Chair	CL/Meeting at BLM	1 Rep. Present
	WSDP	Letter/Meeting at BLM	2 Rep. Present
	Ely Shoshone Chair & ED	CL/Meeting at BLM	0 Rep. Present
	Lois Whitney, WSA	Letter/Meeting at BLM	Present
1-10-01 / 1-18-01	Te-Moak Tribal Chair & ED	CL/Meeting at HH[9]	1 Rep. Present
	Duck Valley Tribal Chair	CL/Meeting at HH	0 Rep. Present
	Elko Band Chair	CL/Meeting at HH	0 Rep. Present
	Battle Mountain Chair & ED	CL/Meeting at HH	1 Rep. Present
	Wells Band Chair & ED	CL/Meeting at HH	2 Rep. Present
	South Fork Band Chair & ED	CL/Meeting at HH	2 Rep. Present
	WSDP	CL/Meeting at HH	2 Rep. Present
	WSHPS	CL	Response 1-17-01
	Lois Whitney, WSA	FAX/Meeting at HH	Present
2-10-01	Te-Moak Tribal Chair & ED	Fax Meeting at BLM	1 Rep. Present
	Duck Valley Tribal Chair	Fax/Meeting at BLM	0 Rep. Present
	Elko Band Chair	Fax/Meeting at BLM	1 Rep. Present
	Battle Mountain Chair & ED	Fax/Meeting at BLM	1 Rep. Present
	Wells Band Chair & ED	Fax/Meeting at BLM	3 Rep. Present
	South Fork Band Chair & ED	Fax/Meeting at BLM	2 Rep. Present
	Ely Shoshone Chair	Fax/Meeting at BLM	2 Rep. Present
	WSDP	Fax/Meeting at BLM	1 Rep. Present
	WSHPS	Fax/Meeting at BLM	0 Rep. Present
	Lois Whitney, WSA	Fax/Meeting at BLM	Present

1 Western Shoshone Historic Preservation Society
2 Environmental Division
3 Information exchange meetings held on a regular basis between the BLM and the Western Shoshone
4 Denotes number of representatives present at the meeting
5 Western Shoshone Defense Project
6 Great Basin College
7 Western Shoshone Advocate
8 Certified Letter
9 Hilton Hotel

APPENDIX B

Summary of the Numerical Ground-Water Flow Modeling for the Leeville Project

APPENDIX B

SUMMARY OF NUMERICAL GROUNDWATER FLOW MODELING FOR THE LEEVILLE PROJECT

INTRODUCTION

A numerical groundwater flow model, referred to as the Carlin Trend Model, was used by Newmont to predict dewatering rates and possible effects on water resources resulting from mine dewatering in the Carlin Trend north of the Humboldt River. This model uses MINEDW, a proprietary code developed by Hydrologic Consultants, Inc. (HCI). This is a three-dimensional, finite-element groundwater flow code that has been tested and verified by Sandia National Laboratory (1998). Sandia concluded that the conceptual model solved by the code is appropriate for the intended use in the Carlin Trend Model, the numerical techniques used are appropriate, and MINEDW correctly solves the mathematical equations.

Information about the model setup and implementation is provided in HCI (1999a). A comprehensive summary of the model and its application in the Carlin Trend is included in Appendix D of the Bureau of Land Management's (BLM 2000) "Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project". Specific information about modeling as it pertains to the Leeville Project is presented in the report, "Numerical Ground-Water Flow Modeling of Leeville Project" (HCI 1999b).

Hydrogeologic conditions in the vicinity of mines in the Carlin Trend are complex due to various hydrostratigraphic units that have been subject to widespread faulting. Regional groundwater flow models are based on a simplified conceptual understanding of hydrogeologic conditions, including structural control, hydraulic characteristics, recharge and discharge, and groundwater flow patterns. Unknown or undetected conditions may exist that could have an influence on dewatering effects that are not predicted by the model. For long-term predictions, there is uncertainty about future climatic conditions. Despite these limitations, numerical models that are based on an accurate conceptual model of the area's hydrogeologic conditions, and properly calibrated, represent the best available tool for predicting effects of mine dewatering.

MODEL DOMAIN

The regional Carlin Trend model encompasses groundwater systems potentially affected by dewatering from major mines north of the Humboldt River: Betze/Post, Gold Quarry, and Leeville mines. This area includes the hydrologic basins of Maggie Creek, Boulder Flat, Susie Creek, Marys Creek, Rock Creek Valley, Willow Creek Valley, and Independence Valley. The proposed Leeville Mine lies within the groundwater cone of depression created by existing mines -- primarily Betze/Post and Gold Quarry. Since water levels in the Leeville area are already lowered, dewatering at Leeville would add to drawdown created by existing and future mine dewatering.

In order to evaluate potential effects of dewatering from the Leeville Mine, two scenarios were modeled: (1) dewatering from the Betze/Post, Gold Quarry, and Leeville mines; and (2) dewatering from only the Betze/Post and Gold Quarry mines (no Leeville dewatering). Results of these two model simulations were compared to determine the specific effects that dewatering at Leeville would have on water resources in the project area. Dewatering rates for Betze/Post and Gold Quarry also included minor pumping from the Genesis, Deepstar, and Sheep Creek Canyon sites.

MODEL UPDATES

The Carlin Trend model was first developed by HCI in the mid-1990s for the Gold Quarry Mine. Additional updates to the model were completed in 1999 by HCI (1999b) based on new hydrogeologic information for the Carlin Trend. Some of the updates relevant to the Leeville Mine include:

- Simulation of some tributaries to the main creeks where flow infiltrates and recharges the groundwater system.
- Addition or movement of faults as barriers to groundwater flow in various locations, including a fault along the eastern boundary of Rock Creek Valley in the Sheep Creek Mountains, several faults around Marys Mountain, the Roberts Mountain thrust under Marys Mountain, and basin bounding fault along western flank of Tuscarora Mountains north of Four Corners.
- Addition of a barrier to groundwater flow north of the Leeville area in carbonate rocks.
- Hydraulic properties of some units were changed to improve steady-state and transient calibrations.
- Addition of predicted dewatering at Leeville which generally consisted of the following pumping rates: 25,000 gallons per minute (gpm) during the first 2 years of operation, 10,000 to 20,000 gpm during years 3 through 5, and 8,000 to 10,000 gpm for the remaining life of the mine.

MODEL RESULTS

The Carlin Trend model predicted areas of lateral and vertical groundwater drawdown resulting from Leeville dewatering. This drawdown would be in addition to drawdown that is occurring and will continue from dewatering primarily at the Betze/Post and Gold Quarry mines. Figure 4-2 in this EIS shows the lateral extent of water table drawdown based on the maximum extent of the 10-foot drawdown contour that is predicted to occur using the Carlin Trend Model. Figure 4-2 shows the 10-foot isopleth for the two model simulations described above under *Model Domain*. Comparison of the two contour lines shows that Leeville would result in a lateral extension of the cone of depression in three relatively small areas: (1) central Boulder Flat area; (2) along drainage divide between Maggie and Susie Creeks; and (3) central portion of Beaver Creek in the upper Maggie Creek basin.

Closer review of HCI's (2001) model results in the Beaver Creek area show that predicted drawdown of the water table would be less than 5 feet near the creek (Figure

B-1). This area, however, was included within the 10-foot isopleth shown on Figure 4-2 in this EIS because a single model node north of Beaver Creek had a predicted drawdown of 12 feet (Figure B-1). The predicted decrease in Beaver Creek flow that may occur as a result of the water table drawdown would be approximately 0.05 cubic feet per second (cfs) or 22 gpm (Figure B-2). Even though there are no flow measurement records for Beaver Creek, other nearby streams in the area indicate that 0.05 cfs is well within the daily fluctuation of natural flow conditions. The lower reaches of these tributary streams typically are dry except during extreme precipitation or snowmelt events. The upper stream reaches (i.e., above 6000 feet elevation) typically have year-round flow due to perched aquifers in the mountains that are not connected to the groundwater system that would be affected by mine dewatering.

Figure 4-3 in this EIS shows the area of more than 10 feet of additional drawdown in the water table aquifer that would be caused by Leeville dewatering within the regional cone of depression. This area extends several miles primarily along a north-south trend from the Leeville site due to structural control by faults. The magnitude of drawdown shown on Figure 4-3 would be additive to lowering of the water table that has occurred and will continue due to dewatering primarily from the Betze/Post and Gold Quarry mines.

The water table aquifer depicted in Figure 4-3 represents layer one of the groundwater model. Layer one at Leeville is composed primarily of Upper Plate rocks (siltstone) that are not in direct hydraulic communication with underlying Lower Plate rocks (carbonate). Most dewatering at Leeville would occur in Lower Plate rocks. Lower Plate rocks are exposed at the surface west and south of the Leeville site (i.e., Tuscarora Spur and Richmond Mountain) and are included in layer one of the model in those areas. Additional groundwater drawdown greater than 100 feet would occur in those areas. A major hydrogeologic boundary, the Tuscarora Fault, limits the amount of drawdown southwest of Leeville in the Marys Mountain and Gold Quarry areas.

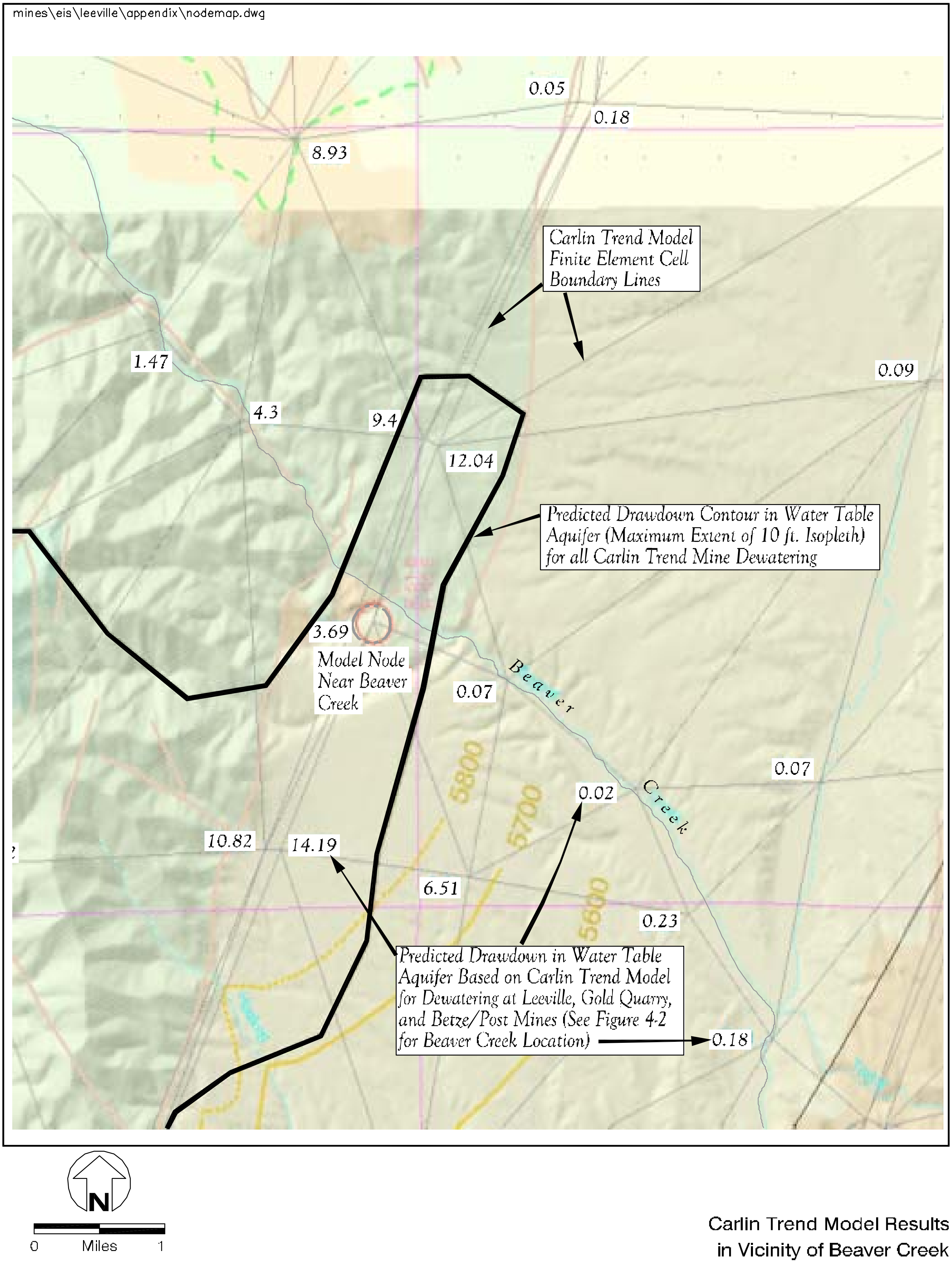
The Carlin Trend Model also was used to predict impacts to stream baseflow in the study area (HCI 1999b). Leeville dewatering is predicted to cause additional reduction in streamflow, on a cumulative basis, of less than 0.1 cfs (45 gpm) for each of Marys, Maggie, and Boulder Creeks. In addition, effects predicted for the Humboldt River would be less than 0.1 cfs flow reduction.

REFERENCES

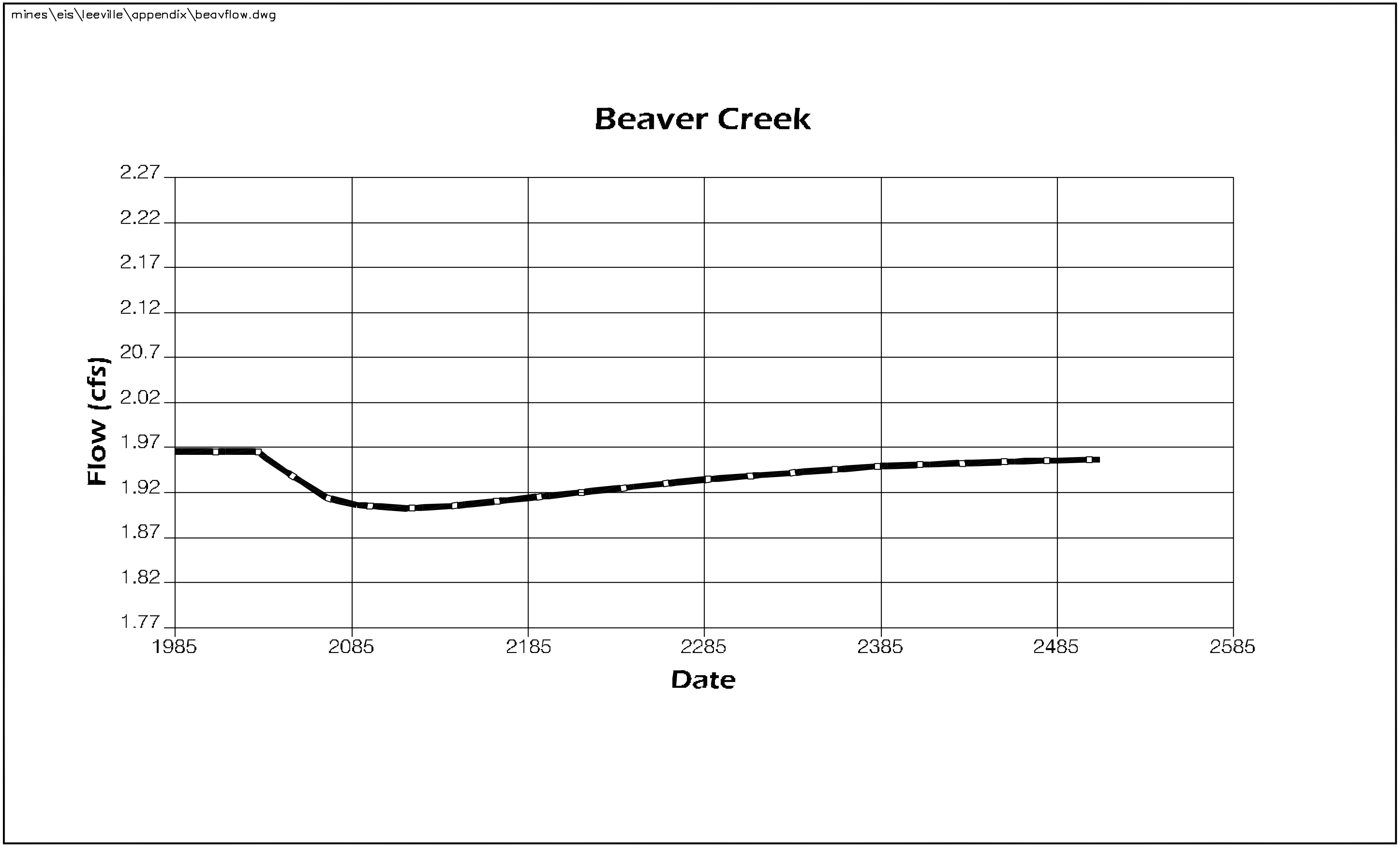
Hydrologic Consultants, Inc. (HCI), 1999a. Prediction of Potential Hydrologic Impacts of Dewatering Operations Along Northern Carlin Trend. Prepared for Newmont Gold Company.

_______, 1999b. Numerical Ground-Water Flow Modeling of Leeville Project, Eureka County, Nevada. Prepared for Newmont Gold Company.

_______, 2001. Results of Groundwater Drawdown and Reduction in Streamflow at Model Nodes for Beaver Creek and Jack Creek for Cumulative Model Run. Submitted via email by Paul Pettit of Newmont Mining Corporation to Maxim Technologies, Inc. on October 16 & 26, 2001.



Carlin Trend Model Results
in Vicinity of Beaver Creek
Leeville Project
FIGURE B-1



Note: Graph shows change in Beaver Creek base flow as predicted by the Carlin Trend Model for the area shown on Figure B-1 resulting from dewatering at Leeville, Gold Quarry, and Betze/Post mines.

Predicted Change in Beaver Creek
Flow from Mine Dewatering
Leeville Project
FIGURE B-2